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HORTUS GRAMINEUS WOBURNENSIS:

OR,

AN ACCOUNT OF THE RESULTS OF EXPERIMENTS

ON THE PRODUCE AND NUTRITIVE QUALITIES

OF DIFFERENT

GRASSES, AND OTHER PLANTS,

USED AS THE FOOD OF THE MORE VALUABLE DOMESTIC ANIMALS:

INSTITUTED BY

JOHN DUKE OF BEDFORD.

ILLUSTRATED WITH

Dried Specimens of the Plants upon which these Experiments have been made,

AND

PRACTICAL OBSERVATIONS ON THEIR NATURAL HABITS, AND THE SOILS BEST ADAPTED TO THEIR GROWTH;

POINTING OUT THE KINDS MOST PROFITABLE FOR

PERMANENT PASTURE, IRRIGATED MEADOWS, DRY OR UPLAND PASTURE, AND THE ALTERNATE HUSBANDRY;

ACCOMPANIED WITH

THE DISCRIMINATING CHARACTERS OF THE SPECIES, AND VARIETIES.

BY GEORGE SINCLAIR,

GARDENER TO HIS GRACE THE DUKE OF BEDFORD,

AND CORRESPONDING MEMBER OF THE CALEDONIAN HORTICULTURAL SOCIETY OF EDINBURGH.

" The soil offers inexhaustible resources, which, when properly appreciated and employed, must increase our wealth, our population, and our physical strength.—Discoveries made in the cultivation of the earth, are not merely for the time and country in which they are developed, but they may be considered as extending to future ages, and as ultimately tending to benefit the whole human race; as affording subsistence for generations yet to come; as multiplying life, and not only multiplying life, but likewise providing for its enjoyment."

DAVY.

LONDON:

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1816.

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TO

THE MOST NOBLE

JOHN DUKE OF BEDFORD,

&c. &c. &c. &c.

THE FOLLOWING ACCOUNT

Of the Results of Experiments instituted by His Grace,

WHICH IS INDEBTED,

For any Merit it may be found to possess, to the truly condescending, and indulgent manner with which the first imperfect essays of the Author in these Researches, were received by His Grace;

AND TO

His Grace's Personal Instructions, most liberal, kind, and unwearied encouragement, bestowed on the efforts of an humble Individual, anxious to prove himself, in some measure, worthy of the trust reposed in him, and of the signal opportunity of devoting those leisure hours which his Horticultural Duties permitted, to obtain and communicate Useful Knowledge in a branch of the most important of the Arts;

Is gratefully inscribed,

By His Grace's

Most obliged,

Most obedient,

And devoted humble Servant,

GEORGE SINCLAIR.

Woburn Abbey, June 25, 1816.

ADVERTISEMENT.

TO those Gentlemen who have so kindly favoured me with information on the subjects connected with this Work, I beg leave to return my sincere thanks. In particular, my best acknowledgments are due

To Sir Humphry Davy, for his very kind and liberal assistance in furnishing the simple chemical process, from which I derived confidence to attempt to realize the idea, first suggested by His Grace the Duke of Bedford, of ascertaining the nutritive powers of the different grasses, by the aids of chemistry; and from the admirable simplicity of his details of the process for analyzing soils, and vegetable substances, given in his important work on Agricultural Chemistry, I have been enabled to execute this difficult part of the enquiry.

To Thomas Greg, Esq. of Coles, for many valuable communications on the most important practical parts of the Work; and his kindness on every occasion of enquiry on the subject of it.

To James Sowerby, Esq. F.L.S. for his assistance in promoting the knowledge of the different agricultural earths, by undertaking to supply those Gentlemen who are interested in the enquiry, with cabinet specimens of the whole of the different soils employed in this series of experiments.

I am likewise much indebted to Mr. Wilson, of the Park Farm, Woburn, for a variety of useful practical information, which he could so well supply.

To Mr. Thomas Gibbs, Seedsman to the Board of Agriculture, I am indebted for information respecting those plants more recently introduced to the Agriculturist, and which I could not otherwise have obtained;—for a collection of the different soils in the vicinity of London, with their local names; and for his willingness on all occasions, to communicate useful information on the subject of the grasses.

Where information has been derived from books, the authorities, in every instance, it is believed, are given.

For reference to descriptions of the different grasses and other plants, upon which experiments have here been made, in those works which contain descriptions only, or descriptions and figures of them likewise, the following abbreviations have been employed.

Allion. Pedem. Car. Allionii Flora Pedemontana, tomi 3, Augusta Tauninorum, 1785, fol.

Bauh. Pinx. Casp. Bauhini Pinax Theatri Botanici, Basiliæ, 1671, 4to.

Cavanill. Hisp. Ant. Jos. Cavanilles Icones et Descriptiones Plantarum, quæ aut sponte in Hispania crescunt, aut in hortis hospitantur, vol. 6, Martiti, 1791-1801, fol.

Curtis. or Flo. Lond. Flora Londinensis, by William Curtis, 2 vols. London, 1798, fol.

Engl. Bot. English Botany, by Sir J. E. Smith, P. L. S. the Figures by James Sowerby, Esq. F. L. S.

Flo. Ger. Flora Germanica, Autore Henrico Adolpho Schrader, tom. 1, cum Tablulis vi. Aeneis, Gottingæ, 1806.

Flo. Britan. Flora Britannica, Autore Jac. Edv. Smith, vol. 1-3, London, 1804-1806, 4to.

Flo. Dan. Icones Plantarum, &c. Hafniæ, 1761, seqq. fol.

Flo. Rust. Flora Rustica: exhibiting accurate figures of such plants as are either useful or injurious in husbandry; drawn and engraved by F. P. Nodder, Botanic Painter to Her Majesty; with scientific characters, popular descriptions, and useful observations, by Thomas Martyn, B. D. and F. R. S. &c. London, 4 vols. 1794, leaves and coloured plates, 144.

Hort. Kew. Hortus Kewensis; or, a Catalogue of the Plants cultivated in the Royal Botanic Garden at Kew, by the late William Aiton. The second edition, enlarged, by W. T. Aiton, Gardener to His Majesty, vol. 1. London, 1810.

Host. Nic. Thomæ Host, Icones et Descriptiones Graminum Austriacorum, vol. 1-3, Vindobonæ, 1801-1805, fol.

Linn. Syst. Car. à Linné Systema Vegetabilium, Gottingæ et Gothæ, 1774, 8vo.

Linn. Spec. Car. Linnæi Species Plantarum, tomi 2, Holmiæ, 1762, 1763, 8vo.

Linn. Suppl. Supplementum Plantarum, &c. à Car. à Linné, (filio), Brunsvigæ, 1781, 8vo.

Moris. Hist. Rob. Morison Historia Plantarum Universalis Oxoniensis, 2 vols. fol. 1699.

Park. Theat. T. Parkinson Theatrum Botanicum, London, 1640, fol.

Raii. Hist. Jo. Raii Historia Plantarum, tomi 3, Londoni, 1686-1704, fol.

Trans. Linn. Soc. Transactions of the Linnæan Society of London; London, 1791, seqq. 4to.

Vahl. Symb. Mart. Vahl Symbolæ Botanicæ, Partes III. Havniæ, 1790-1794, fol.

Willd. Spec. Carr. à Linné Species Plantarum, editio quarta, curante C. L. Willdenow, Berolini, 1797, seqq. 8vo.

Wither. Arr. A Systematic Arrangement of British Plants, &c. by William Withering, M. D. F. R. S. &c. 4 vols. fourth edit. London, 1801.

Ann. Annual.

Per. Perennial.

Bien. Biennial.

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ERRATA.

Introduction, p. xxxi, Specimen XIX. *for* "Stipa pinnata," *read* "Stipa pennata."
Page 24, line 7 from the bottom, *for* "as 9 to 3," *read*, "as 3 to 1."
Page 107, line 34 from the top, *for* "one peck of ray-grass, with fourteen of clover," *read*, "one peck of ray-grass, with fourteen *pounds* of clover."

INTRODUCTION.

Distinguished Agriculturists and Farmers agree in opinion, that the knowledge of the comparative merits and value of all the different species and varieties of Grasses, and, consequently, of the best mode of cultivating them, is very much behind that of the other branches of Practical Agriculture.

Ray-grass *(Lolium perenne)* was till lately the only species employed for making artificial pastures: it was indebted most probably for this distinction, to its property of ripening an abundance of good seed, and its ready growth in most kinds of soil.

The first mention that I find made of ray-grass in early books on husbandry, is in "The Mystery of Husbandry, discovered, and laid open, by I. Woldridge, 1681." "Ray-grass," says he, "by which they improve any cold, sour, clay, weeping lands, for which it is best, but good also for drier upland grounds, especially stony, light, or sandy lands, which is unfit for sainfoin, hath the precedence of all other grasses"—these are "sainfoin, lucerne, clover, tares, spurrey, and trefoil," which include all the plants he mentions as grasses. The account of ray-grass thus concludes: "Four acres of this grass hath yielded twenty quarters of seed and fourteen load of fodder, besides the spring and autumn feeding, whereon six or eight cattle usually grazed."

There is no account of any other species of perennial grass being cultivated till about forty years since, when meadow cat's-tail *(Phleum pratense)* was partially recommended for cultivation; and lately the culture of cocks-foot *(Dactylis glomerata)* has been considerably extended, so as to supersede the use of ray-grass in some districts, through the example and recommendation of Mr. Coke of Norfolk.

Thus out of 215 distinct species of grass, which are capable of being cultivated in this climate, (many of which differ in value from each other, as much as wheat does from pilcorn), two only have been cultivated separately, to any extent. The cause of so much delay in the advancement of improvement in this important branch of the Farmer's art, may appear extraordinary; but there have been serious difficulties in the way.

"Grass," says Professor Martyn, "vulgarly forms one single idea; and a husbandman, when he is looking over his enclosure, does not dream that there are upwards of three hundred species of grass, of which thirty or forty may be at present under his eye. They have scarcely had a name, besides the general one, till within these twenty years; and the few particular names that have been given them, are far from having obtained general use; so that we may fairly assert, that the knowledge of this most common and useful tribe of plants is yet in its infancy*." Botanists have ascertained that there are 133 distinct species and varieties of grass, natives of Great Britain: every one of these species differs, in a less or greater degree, from all others, in the qualities which alone render them of value to the Farmer: comparatively speaking, some grasses are of no value to him, whilst others constitute the foundation of his riches, as they are

* Martyn's Letters on the Elements of Botany. Letter xiii.

the staff of life to the most valuable domestic animals. Now, though the numerous species and varieties of grasses differ so widely from each other in value, yet the similarity which pervades their whole structure is too great, to afford any certain marks of distinction, without having recourse to particular rules, made from a consideration of those parts of their structure which are not subject to vary from culture, or change of situation. The botanical or discriminating characters, of which these rules consist, are often minute, and sometimes perplexing, even to professed Botanists: to those, therefore, who have made Botany no part of their study, the number and difference of value of all the species and varieties of grass, will appear comparatively small, and the necessity and importance of a particular selection proportionally little. The natural consequence resulting from this, is the want of seed, which the Farmer might select from the most valuable kinds, and employ the means of cultivating these, exclusive of the less valuable or useless.

Grasses have been recommended, by persons who had formed their judgment of their merits on imperfect trials, which has caused disappointment, and discouraged many from farther endeavours at improvement. Conclusions that are drawn from the results of single or minute experiments, without accurately ascertaining the nature or qualities of the soils upon which they are made, will be found often fallacious, and even in the latter instance, can only stand for single facts, which may lead to other trials, but cannot furnish sufficient grounds for a general recommendation. Nor should a grass be too hastily rejected; the results of one trial only, will be found insufficient to form a true estimate of its real value: it may be a very profitable plant for permanent pasture, though not for the alternate husbandry, and it may be more valuable for hay than for permanent pasture; for instance, the meadow fox-tail *(Alopecurus pratensis)* is an early, productive, and nutritive grass, but requires a longer period to arrive at perfection from seed than two years: it is therefore, comparatively, unfit for the alternate husbandry, though highly valuable for permanent pasture. The meadow cat's-tail *(Phleum pratense)* is remarkable for its weighty produce of culms, which are more nutritive than those of any other grass, but the aftermath is very inconsiderable; it is, in consequence, a most valuable grass for hay, but requires to be combined with other species of grass, whose produce consists principally of lattermath, to render its culture so profitable. Cock's-foot *(Dactylis glomerata)* arrives soon at perfection; it is early and abundantly productive of nutritive foliage throughout the season; its culms, or stalks, however, are but little nutritive: it is therefore most profitable for the alternate husbandry, or permanent pasture, where culms are less necessary. Under these different relations, therefore, a grass should be considered, before it be absolutely rejected, or indiscriminately recommended. But allowing that the different grasses were easily distinguished from each other with certainty, and that Farmers were in possession of the respective seeds, yet the length of time it would require to prove the relative value of any considerable number of them, by the usual mode of making experiments for this purpose, with the heavy expense attending on failures, would discourage almost any individual from an undertaking which, however beneficial the results might ultimately prove to the community at large, would be attended with a great and certain expense for an uncertain return.

The works of Linnæus, Stillingfleet, Hudson, Curtis, Martyn, the authors of the "English Botany," and many others, have been productive of much good, in calling the attention of Agriculturists to a more particular examination of the comparative merits of the different

grasses, and by affording the means of distinguishing the different species and varieties with more certainty.

The valuable labours of the Agricultural Societies of Great Britain, and the patriotic exertions of eminent individuals in the same cause, have raised a spirit of enquiry, which cannot fail to produce the most beneficial effects in this important branch of practical agriculture. A hope of promoting these views, was the motive that induced His Grace the Duke of Bedford to institute the following series of experiments*.

"Spots of ground, each containing four square feet, in the Garden at Woburn Abbey, were enclosed by boards in such a manner, that there was no lateral communication between the earth inclosed by the boards and that of the garden; the soil was removed in these enclosures, and new soils supplied, or mixtures of soils were made in them, to furnish, as far as possible, to the different grasses, those soils which seem most favourable to their growth, a few varieties being adopted, for the purpose of ascertaining the effects of different soils on the same plant†." The nature of these soils was accurately ascertained by analysis; the process employed, was that recommended by Sir H. Davy. Upwards of two hundred species and varieties of grass were planted or sown at the proper seasons; the different species were cut at certain stages of growth, and the weight of produce carefully ascertained; the particular seasons at which the different species attained to the greatest degree of perfection, were attentively observed, as likewise the time of flowering, and the period of perfecting the seed. Their comparative value, therefore, in regard to produce, and the particular seasons at which it was in perfection, with the kinds of soil most favourable to their growth, and the peculiar habits of the different species, were, by these means, satisfactorily ascertained; but the comparative degree of their nutritive powers, (a point of the first importance), was still to be determined.

Those who have made experiments, to prove the comparative degree of nourishment contained in different species of food, by means of feeding, and weighing, have found the results of such experiments quite inconclusive; and the impossibility of ever determining by *this process*, the *absolute* degree of nourishment supplied to cattle by any kind of food, almost certain; for

First, The quality of the same species of food will often vary, from one to twenty per cent. in the course of the experiment.

Secondly, Different breeds or varieties of animals, acquire various proportions of flesh, from equal quantities of the same species of food consumed by them. Or,

Lastly, Scarcely two individuals of the same breed can be found, that will gain equal weights of flesh from equal quantities of the same kind of food. With a view to this point only, it would therefore have been a vain labour, to have submitted so great a number of different plants to the experiment of feeding and weighing, and which would require at least to be made on four hundred head of cattle of the same breed.

His Grace judged that the enquiry would be effectually assisted by the aids of chemistry; and a simple chemical process, recommended for this purpose by Sir Humphry Davy, ascertained the important point in question in the most satisfactory manner.

* An account of the results of a part of these experiments, is already before the public, through the kindness of Sir Humphry Davy. See "Agricultural Chemistry."

† Ibid.

As this mode of determining the nutritive powers of grasses, by chemical process, is a new path of investigation opened, and such as, on a subject of this consequence, should always be proceeded in with caution at first, it may not be unnecessary to say a few words respecting the accuracy of its results.

The grass, in a green or dry state, is submitted to the action of hot water, till all its soluble parts are taken up. The liquor is then separated from the woody fibre of the grass by means of blotting-paper; it is then evaporated to dryness. The product or solid matter, is the nutritive matter of the grass. Sir Humphry Davy has shown, that the soluble products, or nutritive matter of grasses consist, for the most part, of five distinct vegetable substances, viz. mucilaginous, saccharine, albuminous, bitter extractive, and saline matters; and that "it is probable that the excellence of the different articles, as food, will be found in a great measure proportional to the quantities of soluble, or nutritive matters they afford; but still these quantities cannot be regarded as *absolutely* denoting their value: albuminous, or glutinous matters, have the characters of animal substances; sugar is more nourishing, and extractive less nourishing, than any other principles composed of carbon, hydrogen, and oxygene; certain combinations of these substances, likewise, may be more nourishing than others*."

A certain quantity of food will keep an animal for a great length of time, without increasing or diminishing its weight in any sensible degree; but if the quantity of food be sufficiently augmented under favourable circumstances, the animal becomes fat, and its weight consequently increased. We have no means, however, to ascertain the exact proportions of food required for these two purposes distinctly; for it depends not on the quantity and quality of the food alone; the age of the animal, and its exposure to heat or cold, are also concerned in the process. It is likewise evident, that of two animals of the same breed or variety, the one will frequently acquire a much greater weight of flesh in any given length of time than the other, though both shall have been fed on the same kind of food, and in all other respects treated equally. The nutritive powers of the food cannot therefore be determined absolutely, even by these means, though the comparative merits and value of the different breeds or varieties of animals are thereby fully ascertained; for it is manifest, that it is not the deficiency of nutritive matter in the food, but want of power in the animal to profit by it.

The results of the numerous valuable experiments made by order of the late illustrious Duke of Bedford, to prove the relative value of the different breeds of sheep and oxen, place the truth of the above remarks in a clear light. I may be permitted, therefore, to quote from Mr. Young's "Annals of Agriculture," the results of one of these experiments, which was made on six oxen.

* "Agricultural Chemistry."

" *An Experiment on Six Oxen, from November* 16, 1797, *to December* 10, 1798, *made by order of the late Duke of Bedford.*

		Food given.	Food taken back, or Offal.	Food consumed.	Live Weight, 16th Nov. 1797.			Live Weight, 9th Dec. 1798.			Live Weight gained.		
		Lbs.	Lbs.	Lbs.	Cwt.	Qrs.	Lbs.	Cwt.	Qrs.	Lbs.	Cwt.	Qrs.	Lbs.
No. 1. Hereford Ox.	oil-cake	—	—	—	17	0	1	18	3	0	1	2	27
	turnips	3060	360	2700									
	hay	530	43	487									
No. 2. Hereford Ox.	oil-cake	450	26¼	423¾	18	1	0	21	0	25	2	3	25
	turnips	3040	328	22,712									
	hay	467	34½	432½									
No. 3. Devon Ox.	oil-cake	450	11¾	438¼	14	1	7	17	2	7	3	1	0
	turnips	3090	422	2668									
	hay	376	81	295									
No. 4. Devon Ox.	oil-cake	450	7¼	442¾	14	2	14	19	1	0	4	2	14
	turnips	3000	364	2636									
	hay	475	32½	442½									
No. 5. Sussex Ox.	oil-cake	450	17½	432½	16	2	0	19	3	0	3	1	0
	turnips	3030	375	2655									
	hay	443	51	392									
No. 6. Leicester Ox.	oil-cake	450	15¼	434½	15	2	14	18	2	0	2	3	14
	turnips	3010	358	2652									
	hay	447	46½	400½									

The oxen were weighed on the day that they were put up for experiment; the food that was given to them daily, was likewise weighed, and the refuse or offal was taken back, and its weight ascertained: hardly any thing could be more satisfactory than this mode of conducting the experiment.

The Devon ox, (No. 4), on a less weight of food, gains 185 lbs. of flesh more than the Hereford ox, (No. 2): but suppose that the difference of the breed should have had much influence in this instance, the difference between the two Devon oxen, (No. 3, and No. 4), is very striking; for though the weight of food consumed by each is nearly equal, the latter gains 154 lbs. of flesh more than the former. Viewing the results of this experiment, therefore, merely as a test for proving the comparative degree of nourishment contained in these several species of food, and not as a proof of the relative value of the respective breeds of animals, (for which this experiment was made, and fulfilled the intention), we could arrive at no satisfactory conclusion; because it still remains to be proved, whether another individual of the same breed as the ox, (No. 4), might not have gained a greater proportion of flesh from the same weight of food as was consumed by the latter.

If the weight of nutritive matter which the chemical process shews these different species of food contains, be now compared with the weight of flesh which the different oxen gained from it, the comparison will manifest the superior utility of this new mode of investigating the nutritive qualities of the food of these animals.

	Food consumed.		Weight of Nutritive Matter by the Chemical Process.			Weight of Flesh gained by the Oxen.			Difference between the Weight of Nutritive Matter and that of the Flesh gained.		
	Lbs.	Oz.	Lbs.	Oz.	Dr.	Cwt.	Qrs.	Lbs.	Cwt.	Qrs.	Lbs.
No. 1. Hereford Ox.		oil-cake	—								
	2700	0 turnips	132	0	0	2	0	20	1	2	27
	487	0 hay	112	0	0						
No. 2. Hereford Ox.	423¾	0 oil-cake	116	8	0						
	2712	0 turnips	134	3	0	3	0	14	2	3	25
	432½	0 hay	99	7	0						
No. 3. Devon Ox.	438¼	0 oil-cake	120	7	3						
	2668	0 turnips	132	0	5	2	3	12	3	1	0
	295	0 hay	67	9	10						
No. 4. Devon Ox.	442¾	0 oil-cake	121	8	0						
	2636	0 turnips	130	7	7	3	0	18	4	2	14
	442½	0 hay	101	15	0						
No. 5. Sussex Ox.	432	0 oil-cake	118	12	0						
	2655	0 turnips	129	8	0	3	1	9	2	3	18
	392	0 hay	125	0	0						
No. 6. Leicester Ox.	434½	0 oil-cake	119	7	0						
	2652	0 turnips	129	0	0	3	1	12	2	3	14
	400½	0 hay	127	9	0						

	0	1	21,	in which the nutritive matter exceeds the flesh.	
	0	0	17,	in which the nutritive matter exceeds the flesh.	
	0	1	16,	in which the flesh exceeds the nutritive matter.	
	1	1	24,	in which the flesh exceeds the nutritive matter.	
	0	1	19,	in which the nutritive matter exceeds the flesh.	
	0	1	26,	in which the nutritive matter exceeds the flesh.	

The only point assumed in the foregoing comparisons, is the quality of the hay, or the kinds of grasses that composed it, of which, in the account of the experiment quoted, no mention is made. Likewise, some linseed cakes are much more nutritive than others; I have found them to vary from 67, to 132 grains, in every 480 grains of cake. Those cakes which had the brightest texture when newly broken, afforded the most nutritive matter. The common field turnips also differ in the quantity of nutritive matter they afford, which is in proportion to the size of the roots, or according as their texture is solid or spongy: the largest roots contain proportionally the least quantity of nutritive matter, and the middle-sized the greatest. These are minute circumstances in experiments on a small scale, but when conducted on a large scale, they become objects of magnitude. A nearer coincidence between the results of the two modes of experiment for the respective oxen, could not therefore be expected; but the total weight of flesh gained in this experiment, nearly agrees with the weight of nutritive matter contained in the food consumed by the oxen. The weight of the different kinds of food consumed, amounts to 20,656 lbs., which being of a middle quality, as assumed in the foregoing calculations, affords, by the chemical process, (see the Table), 2020 lbs. of nutritive matter.
The total weight of flesh gained, is 2058 lbs.

It is therefore evident, that if the weight of nutritive matter contained in the various kinds of food employed in this experiment, had been previously ascertained as above, it would have shewn the weight of flesh which that food was capable of forming *under such circumstances*, with the difference only of 38 lbs. in 2058 lbs. But, as was before observed, the different powers of cattle to profit by food, is subject to the control of many local circumstances; their comparative value therefore, in this respect, can only be satisfactorily ascertained by the process of feeding and weighing; and for this cause likewise it will appear, that the comparative value, or nutritive powers of the food, can only be accurately ascertained by chemical investigation. The gramineous dung of cattle being merely the grass, divested of all its nutritive matter, by

submitting this dung to a similar process as that which determines the nutritive powers of the grass, the results prove what those parts of grass are, that are retained in the body of the animal for the purposes of life. The following results of experiments made on the dung of sheep, and deer, will be sufficient to exemplify this.

1920 grains of the mixed leaves of cock's-foot grass, ray-grass, and white clover, afforded of soluble matter fifty-three grains, which consisted of mucilage, sugar, gluton, bitter extractive, and saline matters.

1920 grains of the dung of sheep which fed on these grasses, afforded of soluble matter thirteen grains and a half, consisting of bitter extractive, and saline matters.

1920 grains of the dung of deer, which also fed on these grasses, afforded eleven grains and three quarters, of the same nature as that of the sheep.

The bitter extract, or soluble matters of the dung, was examined chemically by Sir H. Davy; he found its qualities to be so analogous to the bitter extractive of the grasses, that they might be mistaken for each other. The extractive matter obtained by boiling the fresh dung of cows, gave similar results.

From these facts Sir H. Davy observes, " it appears probable that the bitter extract, though soluble in a large quantity of water, is very little nutritive; but probably it serves the purpose of preventing, to a certain extent, the fermentation of the other vegetable matters in the stomach, or in modifying or assisting the functions of digestion, and may thus be of considerable use in forming a constituent part of the food of cattle. A small quantity of bitter extract and saline matter, is probably all that is needed; and beyond this quantity the soluble matter must be more nutritive, in proportion as they contain more albumen, sugar, and mucilage, and less nutritive, in proportion as they contain other substances."

To these, I may be permitted to add the results of another trial, which I made on the dung of sheep that had fed on turnips, as it may afford some information on the nature of turnips as food for sheep.

1920 grains of the yellow Scotch turnip, on which sheep were feeding, afforded of nutritive matter 85 grains, which consisted of,

Mucilage, - - - - - -	9 grains.
Saccharine matter, or sugar, - - -	73
Bitter extractive and saline matters, - -	3

1920 grains of the dung of the sheep which had fed on the yellow turnips, afforded of soluble matter, by means of a large quantity of water, 17 grains, which consisted of,

Animal mucous and mucilage, - - -	3 grains.
Bitter extractive and saline matters, - -	14

The most remarkable circumstance here, is the superior quantity of bitter extractive in the dung, to that which is shewn to exist in the turnips; but the sheep had hay, on which they occasionally fed in the field, and on examining the insoluble portion of the dung, (after separation from the soluble parts), nearly one-fourth part in weight consisted of the woody fibre of hay, which evidently had afforded the extra quantity of bitter extractive to the dung.

The sheep ate of the hay from choice, and not necessity, and it is more than probable, that the bitter extractive it contained, was, under such circumstances, the most valuable part of its nutritive matter, in supplying the deficiency of it in the turnips.

It is worthy of observation here, that the leaves or herbage of the common pasture grasses, contain nearly the like proportion of bitter extractive as that in the dung; the sheep, therefore, in *this instance*, had taken that proportion of hay which, combined with the turnips, formed a natural food, or that which had nutritive qualities analogous to natural pasture.

The dry fibre of the hay or straw given with turnips, may also assist mechanically in correcting the watery nature of this food, in the cold season of the year in which it is given to sheep, when an excess of moisture may be more hurtful than in a warmer season.

In some plants there is a comparative excess of saline matter, and when such plants are given unmixed with any other to cattle, they are most subject to disease, or continue for a length of time before they improve, however abundant the supply. The following facts, which came within my own immediate observation, may serve as an instance to point out the importance of a mixture of such grasses as possess some difference in the qualities of their nutritive matter; and at the same time they will shew, that the bitter extractive is efficacious in correcting the over-succulency, or laxative nature of green food, without the aid of *dry* vegetable fibre.

Two fields were sown down for pasture; one with white clover, and trefoil only, and the other with a variety of the natural grasses, for experiment, with a portion of white clover. The two fields were depastured with sheep. In the enclosure of white clover a considerable quantity of cock's-foot grass grew on the edge of the fence; it was of a very harsh quality, from its unfavourable situation, and consisted almost entirely of culms. In a few days the sheep went to this grass, and ate it down entirely, though there was a profusion of the white clover. In the course of time many of the sheep became affected with the disease termed *red-water*, of which several died. But in the adjoining field, which contained the natural grasses, cock's-foot grass, rough-stalked meadow grass, rye-grass, foxtail-grass, and white clover, the sheep were not affected with that, nor any other disease, and they left untouched the stems of the cock's-foot, which were here of a more tender succulent nature, than those on the edges of the other field, which were so greedily devoured by the clover sheep.

It may remain only to observe, that if the hard stalks of the cock's-foot in the clover field had been in sufficient quantity, they would most probably have prevented the disease from attacking the sheep; but this could not have been by virtue of the *dry fibre* only of the culms, because in the adjoining field, where every thing was contrary to disease, the sheep rejected the culms altogether. The dry, or mechanical action of the culms, was here wanting; yet the animals continued healthy, and fattened, because the bitter extractive was in greater proportion in the leaves or herbage than in the culms which they rejected, and also proved beneficial, though combined with succulent food, which could have nothing of the action of the dry hay or straw before mentioned.

The succulency, or the quantity of superfluous moisture contained in the food of cattle, and the relative proportions which the saline matter, and bitter extract, bear to the gluten, sugar, and mucilage of the nutritive matters of different plants, influencing thus their nutritive powers when used in a green state; these properties, therefore, will be particularly considered in esti-

mating the comparative value and merits of the different grasses, and other plants, that will hereafter be recommended to the notice of the Agriculturist.

A knowledge of the quantity of soluble or nutritive matter afforded by different crops, and the number and proportion of the nutritive vegetable principles formed by them, will be found likewise to throw light on the cause of the exhausting or impoverishing effects of different plants to the soil; a point of much importance, as connected with the theory and practice of alternate cropping with green crops and grain. The facts which have offered themselves in support of this, will be stated hereafter, when the merits of the grasses, and ameliorating plants adapted to the alternate husbandry, come under discussion.

It was before remarked, that the little attention that has been paid by Agriculturists in general, to distinguish with certainty the different species of grass from each other, has contributed to retard improvement in the cultivation of this numerous family of plants. It will, I hope, appear perfectly evident, that without the means of distinguishing with certainty one species of grass from every other, the cultivator must have recourse to other men's assistance or experience, before he can make any certain, or just experiments of his own, and consequent improvement.

When it is found that every distinct species of grass differs from all others, more or less, in the properties or merits which alone constitute their value to the Agriculturist, a bare enumeration of all the different species and varieties, may be sufficient to shew of what utility the knowledge of distinguishing the grasses is to the Farmer: and a view of those rules of which this knowledge consists, will manifest how easily it may be acquired, without entering into the study of the *whole* science of Botany, by any person who will devote a few leisure hours to attain it.

If there are any, who may doubt of the utility of botanical knowledge to the ends of Agriculture, as above stated, it must proceed from the want of experience, as a very little of this in the cultivation of these plants, with a view to improvement, will produce a conviction to the contrary—that it is the only clear, and direct road to this end, and likewise the most pleasant.

It cannot fail, therefore, to be of use, before entering into the details of the experiments, to give an explanation of the terms made use of in describing the structure of grasses, with a general view of all the different species and varieties.

One species of grass is distinguished from every other by its properties, and by the number, situation, proportion and color of the different parts of its structure. Of these parts, the most obvious are, the root, *(radix)*; the straw, stem or culm, *(culmus)*; the leaves, *(folia)*; the flower or husks, *(Flos* v. *Gluma)*; and the seed, *(semen)*. The figure of these parts vary in different species: it is therefore absolutely necessary, that every variety have a name, by which it may be distinguished from every other. It is remarked somewhere, that the results of our reasonings must needs be very confused, or even absurd, without precise ideas being fixed to our words.

I.

The Varieties of the Root are:*

1. Fibrous, (*fibrosa*), when the root is composed of a number of threads or fibres, as in most grasses. See *Agrostis fascicularis.*
2. Creeping, (*repens*), when the root runs horizontally in the earth, and pushes up culms from the joints, as in *Triticum repens, Holcus mollis, &c.*
3. Bulbous, (*bulbosa*), when the root consists of a solid substance of a spherical form, as in *Hordeum bulbosum*†.

II.

The Varieties of the Straw, Stem, or Culm, are:

1. Quite simple, (*simplissimus*), without any branches, as in *Melica cærulea.*
2. Simple, (*simplex*), that sometimes has more than one branch, as in *Poa nemoralis.*
3. Somewhat branched, (*subramosus*), that has often several branches, as in *Agrostis Mexicana.*
4. Erect, (*erectus*), when the straw stands nearly perpendicular, as in *Alopecurus pratensis.*
5. Straight, (*strictus*), when the stem is quite straight, as in *Trichodium rupestre.*
6. Ascending, (*ascendens*), when the lower part of the straw lays on the ground, and the upper part of it grows upright, as in *Poa compressa.*
7. Decumbent, (*decumbens*), when the lower part of the straw rises in an oblique direction to the horizon, and the upper part bends down towards it. See *Festuca decumbens.*
8. Procumbent, (*procumbens*), is when the straw lies flat on the ground, without striking roots at the joints. See *Poa procumbens.*
9. Creeping, (*repens*), when the straw creeps on the ground, and sends out roots from the joints, as in *Agrostis stolonifera.*
10. Naked, (*nudus*), having very few leaves with short sheaths, as in *Melica cærulea* and *Festuca ovina.*
11. Bristle-shaped, (*setaceus*), with short sheaths and slender stem, as in *Festuca tenuifolia.*
12. Round, (*teres*), that is, cylindrical. See *Festuca glabra.*
13. Half round, (*semiteres*), that is, flat on one side and round on the other. See *Poa fertilis.*
14. Compressed, (*compressus*), when the stem is flat on both sides. See *Poa compressa.*
15. Two-edged, (*anceps*), when a compressed straw is sharp on both edges. See *Poa aquatica.*
16. Four-cornered, (*tetragonus*), three or four round or obtuse edges, but the sides flat. See *Festuca ovina.*

* To those, who wish to enter fully into the study of Botany, I may be permitted to recommend Dr. Smith's "Introduction," or that by Dr. Willdenew, Withering, and Thornton, as adapted to afford every facility; having consulted each of these works, in what relates to the Grasses.

† A bulb is compared to a bud under ground, producing shoots from its middle or sides; the bulbs of the crocus, or hyacinth, is not properly the root, but a part of the stem; the fibres are the proper roots. The carrot, turnip, potatoe, &c. are tuberous roots, for these have eyes formed on the surface, which particularly distinguish them from bulbs properly so called.—*Willdenew.*

17. Knee-jointed, (*geniculatus*), when the stem is bent at a joint, like the knee. See *Elymus geniculatus*.
18. Bulbiferous, (*bulbifer*), having bulbs, or buds, fixed at the joints. See *Phleum nodosum*.

The flower straw, (*pedunculus*), is the part which immediately supports the flower; it may be either a part of the principal straw, as in wheat, or barley, or composed of a number of partial straws seated on the principal culm, (see *Bromus sterilis*); or these partial straws again branched, as in *Poa nervosa*, and *Trichodium rupestre*: in the two last cases, they constitute what is called a compound panicle.

III.

Varieties in the form of the Leaves.

The leaves of grasses are all quite simple, or undivided, and, on that account, afford but few obvious characters of distinction; they vary, however, in respect of the form of their point or apex, circumference, situation, and surface-covering.

The apex, or point, is either acute, (*acutum*), as in *Poa trivialis;* or obtuse, as in *Poa pratensis*. The circumference has four varieties:

1. Sword-shaped, (*ensiforme*), an oblong leaf, growing gradually narrower towards the apex, which is pointed. See *Festuca cambrica*.
2. Strap-shaped, (*lineare*), when both sides of a leaf run parallel to each other. See *Sesleria cærulea*.
3. Awl-shaped, (*subulatum*), a linear leaf, when it is sharp-pointed, as in *Poa glauca*.
4. Fringed, (*ciliatum*), when the edges are set round with long hairs, as in *Festuca sylvatica*.

The surface of the leaves vary as follows:

1. Channelled, (*canaliculatum*), when the middle rib of the leaf is furrowed, as in *Festuca duriuscula*, (R. leaves.)
2. Nerved, (*nervosum*), when the vessels, or ribs, are strongly marked, and run from the base to the apex, lengthwise, as in *Bromus littoreus*.
3. Bristle-shaped, (*setaceum*), when the leaves are nearly cylindrical, resembling swine's bristles, as in *Festuca ovina*.
4. Flat, (*planum*), when the surface of the leaf is even, without any furrows, dots, or raised veins, as in *Poa fluitans*.

In respect of situation, the leaf varies:

1. Slanting, (*obliquum*), when the leaves are in a direction between sloping and horizontal, as in *Phleum nodosum*.
2. Horizontal, (*horizontale*), when the leaves grow nearly horizontal, as in *Dactylis patens*.
3. Bundled, (*fasciculare*), when the leaves grow in tufts, or bundles, as in *Agrostis fascicularis*.

Sheath, (*vagina*), is the lower part of the leaf, that encloses the straw in the manner of a sheath.

Sheath-scales, or stipules, (*stipulæ*), of grasses, are small membranaceous substances attached to the inner sides of the leaves; they have their origin at the top of the vagina, or the point where the leaf first diverges from the straw. Its varieties are:

1. Intire, (*integra*), when it has no segments.
2. Bifid, (*bifida*), when it is divided at the apex into two parts.
3. Torn, (*lacera*), when it appears as if torn on the margin.
4. Fringed, (*ciliata*), when the margin is set with short projecting hairs.
5. Truncated, (*truncata*), when the upper part terminates in a transverse line.
6. Pointed, (*acuta*), that has a short acute point.
7. Accuminated, (*accuminata*), that has a long projecting point.
8. Very short, (*decurrens*), that is hardly visible, and runs down the side of the vagina.

The stipules often afford a good character of distinction. I have raised a great many species of different grasses from seed, under different circumstances, as to soil and situation, with a view to obtain varieties from them. I found many of the plants thus raised, to vary from the parent, in the number of the flowerets, in the presence or want of hairs on the surface, and sometimes, though rarely, in the awns; but in no instance did the form of the stipula or sheath-scale vary: being thus constant, it may be depended on.

IV.

Varieties of the Flower.

The curious structure of the flowers of grasses, and a consideration of their important office, that of forming the seed, is sufficient to attract notice or regard, independent of the great use, of which a knowledge of their structure is, in distinguishing with certainty the several species and varieties.

Inflorescence, or the manner in which the flowers of grasses are supported and disposed on the culms, affords the most obvious characters of distinction: it is of two kinds, the spike and the panicle.

The spike, (*spica*), is a number of flowers without footstalks, that closely surround one principal, simple straight culm. (See *Pedunculus.*)

1. Glomerata, (*glomerata*), when the spike consists of a spherical collection of flowers, as in *Sesleria cærulea.*
2. Verticillated (*verticillata*), when the flowers, leaving naked interstices on the spike, appear on that account to be placed in whirls, as in *Panicum verticillatum.*
3. One-rowed, (*secunda*), when the flowers are arranged on one side, as in *Nardus stricta.*
4. Cylindrical, (*cylindrica*), when the spike is equally covered with flowers. *Panicum viride.*
5. Linear, (*linearis*), that is, slender, and of equal thickness, as in *Cynosurus erucæformis.*
6. Ventricose, (*ventricosa*), thicker in the middle than at both extremities, as in *Alopecurus agrestis.*
7. Leafy, (*foliosa*), having leaves between the flowers, as in *Cynosurus cristatus.*

8. Compound, (*composita*), when several spikes stand on one stalk, as in *Cynosurus erucæformis.*
9. Finger-like, (*digitalis*), when several spikes stand on one straw, spread out in the manner of the fingers of the hand, as in *Panicum sanguinale.*

The spike-stalk, (*rachis*), is a long rough slender receptacle, on which the flowers composing a spike are placed. Take a spike, says Professor Martyn, (or rather, as it is commonly called, an ear), of wheat, pull off all the seed and chaff, and what remains is the spike-stalk, or rachis.

The spiket, or ear, (*spicula*), consists of several florets enclosed by one calyx. It is distinguished by the number of flowers it contains, as one-flowered in *Agrostis*, two-flowered in *Aira*, three-flowered in *Poa glauca*, many-flowered, as in *Bromus multiflorus.* It is likewise described according to the figure it assumes, as cylindrical, oval, linear, &c.; and with respect to its surface, as smooth, rough, hairy, &c.

The panicle, (*panicula*), consists of flowers supported by foot-stalks loosely dispersed or scattered; the flowers of oats serve as an example, or as in *Poa pratensis.* The varieties of the panicle are:

1. Simple, (*simplex*), that has only undivided side-branches, as in *Poa decumbens.*
2. Branched, (*ramosa*), when the first branches are again divided, as in *Bromus multiflorus.* Vide specimen.
3. Much-branched, (*ramosissima*), when the branches are much branched, as in *Trichodium caninum*, vel *Agrostis canina.* Var. *mutica.* Vide specimen.
4. Spreading, (*patentissima*), when the branches stand wide from each other, and spread out in all directions, as in *Agrostis repens.*
5. Crowded, (*coractata*), when the branches stand very near together, as in *Agrostis palustris.*
6. One-rowed, (*secunda*), when the branches stand on one side, as in *Festuca glabra.*
7. Nodding, (*nutans*), when the branches bend down towards the horizon—*Bromus tectorum.*

V.

The Flower consists of,

Five distinct parts, the calyx, or outer husks, (*gluma*); the corolla, or inner husks, (*corolla*); the stamina, or male parts, (*stamina*); the pistil, or female parts; and the germen, or rudiment of the future seed.

The calyx, or outer husks, contains the flower, and afterwards the seed. Its more obvious characters of distinction consist in the number of valves, or scales, of which it is composed.

1. One-valved, (*univalvis*), that consists of only one valve, as in *Lolium*, (rye-grass).
2. Two-valved, (*bivalvis*), that consists of two valves, as in most grasses.
3. Many-valved, (*multivalvis**), when the outer husks consist of more than two valves, as in *Hordeum*, (barley), and *Elymus*, (lyme-grass).

* The *involucre*, or leaves like spines, which surrounds one or several flowers, is sometimes found in grasses, but is more particularly the property of another order of plants, (the *umbelliferous*); and, being in the grasses much resembling the glumes of

4. Keeled, (*carinatus*), bent like the keel of a ship or boat, as in *Phalaris canariensis*.
5. Fringed, (*ciliatus*), having soft hairs set round the edges, as in *Phleum pratense*.
6. Lopped, (*truncatus*), when the apex appears as if cut horizontally, as in *Phleum pratense*.
7. Prickly, (*cuspidatus*), ending in dagger-like points, as in *Phleum pratense*.

The corolla, or inner husks, contains the essential parts of the flower, (staminæ, style, and germen); when the seed is perfected, they generally enclose and adhere to it. This, and the calyx, constitute the chaff of oats, wheat, &c. It has the following varieties:

1. One-valved, (*univalvis*), which consists of one valve only, as in *Trichodium rupestre*.
2. Two-valved, (*bivalvis*), as in most grasses.
3. Awned, (*aristata*), when furnished with an awn.
4. Awnless, (*mutica*), wanting the awn.
5. Ribbed, (*nervosa*), when the valve has nerves, or veins, which run from the base to its apex, as in *Poa nervosa*.
6. Fringed, (*ciliata*), as in *Phleum pratense*.

The valves are also distinguished according to their figure, as, oval, oblong, concave, egg-shaped.

The stamina are the male parts of fructification. Each consists of three parts—the filament, the anther, and the pollen, or flower-dust. The filament is a long thread-like substance, which supports the anthers. The anther is a cellular body of a linear figure, generally cloven at both ends; it contains the pollen, which is essential to the production of the seed. It varies in respect of colour, as,

White, in *Phleum echinatum*.
Yellow, in most grasses.
Saffron, in *Bromus erectus*.
Purple, in *Melica cærulea*.

The pistil, (*pistilium*), is the female part of the flower, and likewise consists of three parts—the germen, the style, and the stigma.

The germen is situated at the bottom of the flower; it appears a pellucid globular body, but in general it requires the aid of a microscope to see it distinctly. It is the rudiment of the future seed.

The style consists of two feather-like bodies, seated on the top of the germen: they are generally bent back, or reflexed.

The stigma, terminates the style, and gives to it that feather-like appearance.

The nectary, (*nectarium*), is likewise a part of the flower of some grasses; it is supposed to serve the purpose of a reservoir for the honey-juice: in structure, it generally resembles the

the calyx, I have included it here, under the distinction multivalve calyx; merely to avoid too numerous divisions, which, to those who confine their study of Botany only to the Grasses, (for whose use these pages are only designed), will be, I trust, useful.

corolla husks; but it is very minute, tender, and finely transparent. The terms employed to describe the corolla, likewise apply to this. It is not found in the genus *Nardus*, *Eriophorum*, *Alopecurus*, or *Sesleria*.

VI.

Varieties of the Seed.

The discriminating characters of the seeds of grasses are confessedly minute; but as the form of the seed is never known to vary, except by disease, the marks of distinction it offers, are of the most unerring kind. In most grasses the seed is covered, or enclosed, by the husk, which was formerly the blossom, (*corolla*); in other species the seed is naked, or so loosely attached to the husk, as to separate from it in the process of cleaning.

If the seeds of every species of grass were naked, their diminutive size would hardly afford any obvious marks of distinction; but the coat, or seed-vessel, (*pericarpium*), gives variety to the form of those seeds, which are otherwise very much alike.

The discriminating characters of the seed being thus minute, and resting almost always on the various shades of dissimilarity assumed by three or four principal figures, as, round, oval, oblong, and acuminate, or pointed, it is therefore easy to conceive, that such distinctions are often readily perceived by the eye on comparison, but with difficulty conveyed by mere description; indeed it may be said, that a few hours' practice in comparing the different kinds of seed with each other, is worth a volume of description, for practical purposes. With this view, and also to shew where the principal characters of distinction take their rise, the following specimens, illustrative of the different genera, are selected.

I.

ANTHOXANTHUM odoratum.

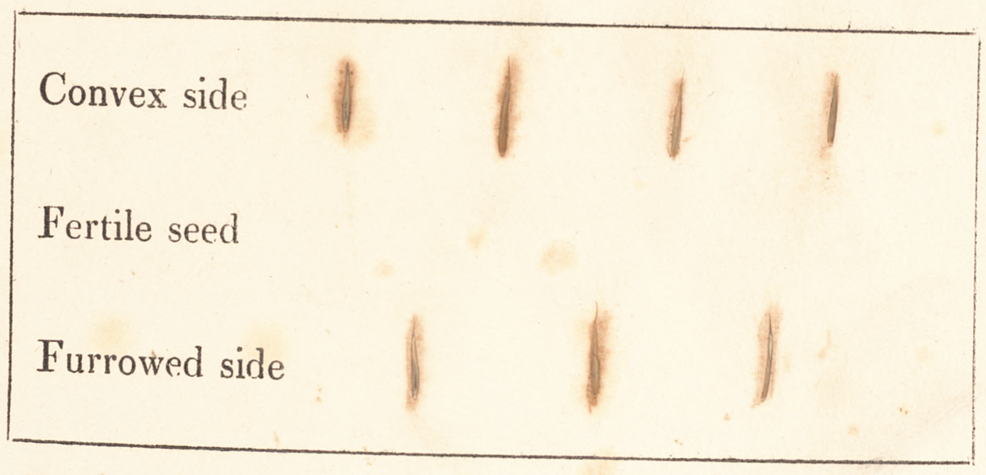
Sweet-scented Vernal-*grass.*

The seed is covered with the husks of the blossom, which adhere to it; the naked seed is nearly cylindrical, but tapering to a point at each end. The diseased seed was produced by over-luxuriant plants, during very wet weather.

II.

NARDUS stricta.

Upright Mat-*grass.*

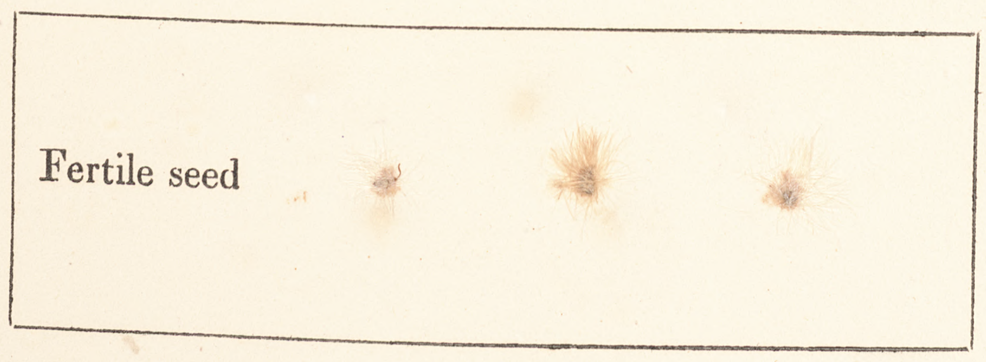


The seed is covered with the husks of the blossom, which closely adhere to it, nor open; it is convex on one side, and marked with a longitudinal furrow on the other. The naked seed is linear-oblong, tapering to a point at each end, the upper end the narrowest. Not subject to disease.

III.

ERIOPHORUM vaginatum.

Sheathed Cotton-*grass.*



The long white hairs attached to the seed of the different species of cotton-grass, particularly distinguish it; the body of the seed is three-cornered.

IV.

PHALARIS canariensis.

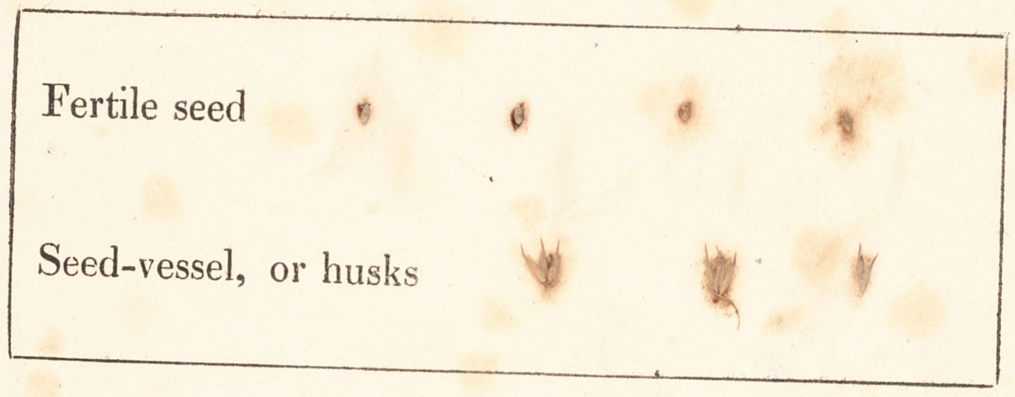
Canary-*grass.*

The seed is covered with the husks of the blossom, like a crust, nor opens; from a round, it becomes tapering to a point at both ends.

V.

PHLEUM pratense.

Meadow Cat's-tail *grass.*



The seed is loosely covered with the husks, which separate from it in cleaning; the naked seed, as shewn above, is roundish. The two valves which constitute the husk, or seed-vessel, are furnished with straight white hairs on the back: they also terminate with two dagger-like points, which afford a good character of distinction between this and the seed of fox-tail grass, (*Alopecurus*).

VI.

PANICUM glaucum.

Glaucous Panic-*grass.*

The seed is covered with the inner husks of the blossom, which do not open; the body of the seed is round on one side, and flat on the other.

VII.

ALOPECURUS pratensis.

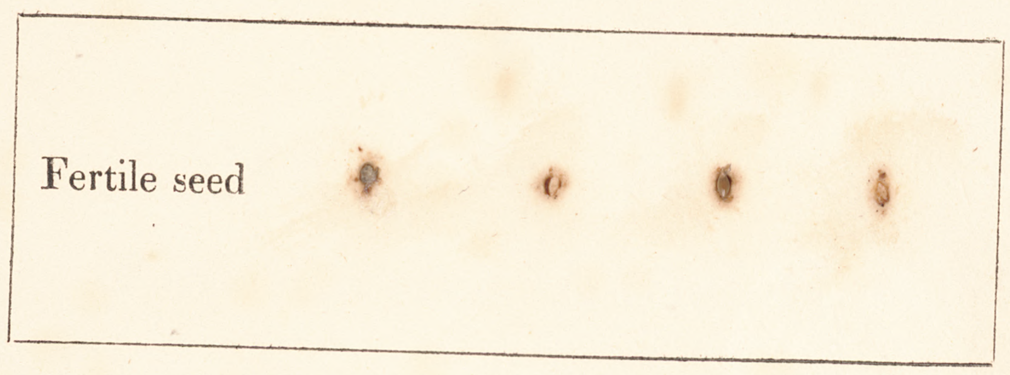
Meadow Fox-tail *grass.*

The seed is covered with the husks of the blossom; the larger valve is furnished with an awn. Insects eat this seed while it is in embryo: it is subject to blight; and likewise to the disease termed clavus, as shewn in the above specimens. Yet the effects of all these might in a great measure be prevented, by simply permitting the *first* shoots of the season to carry the seed.

VIII.

MILIUM effusum.

Millet-*grass.*



The husks of the blossom cover the seed; the body of which is roundish, and very smooth.

IX.

AGROSTIS stolonifera.

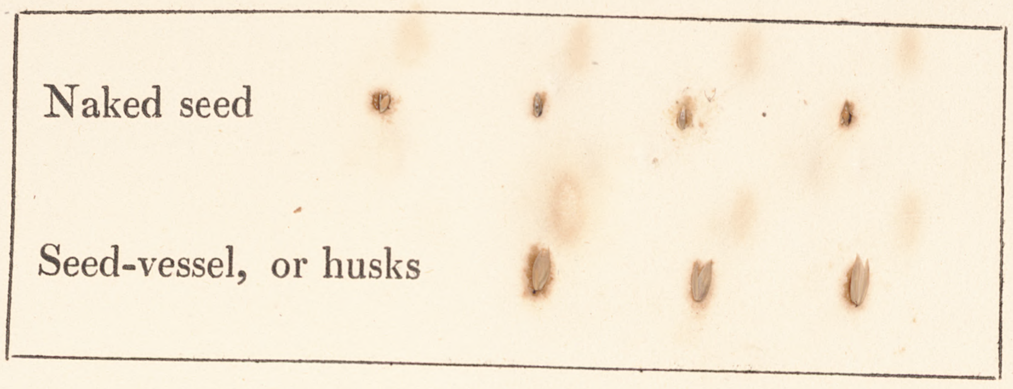
Stoloniferous Bent-*grass.*

The seed is covered with the husks of the blossom, which do not open; it is cylindrical, but tapers to a point at each end.

X.

HOLCUS lanatus.

Woolly Soft-*grass.*

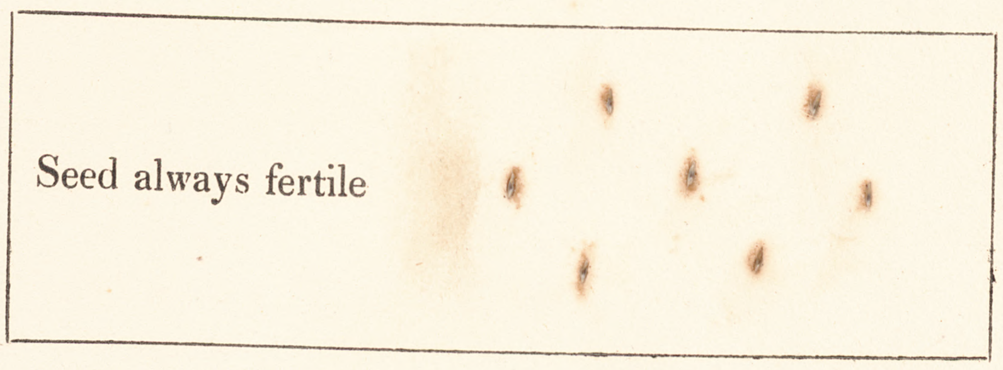


The outer and inner husks, in general, adhere to the seed, and cover it: they are egg-shaped, and furnished with a short bent awn; the body of the seed is egg-shaped, and very smooth. The seed of the *Phleum*, or cat's-tail grass, (No. V.), is always naked, and being of a round form, sufficiently distinguishes it from the above; the forked termination of the husks of the *Phleum*, likewise affords an easy distinction between their seed-vessels. The seed of the *Alopecurus*, or fox-tail, (No. VII.), is distinguished from these by its covering, or husks, being permanent, and terminating in a straight awn. The Agriculturist will find it his interest to distinguish between these seeds.

XI.

AIRA cæspitosa.

Turfy Hair-*grass*, or Hassocks.



The seed is covered with the inner husks, which adhere to it: it is egg-shaped; a tuft of woolly hairs which proceeds from the base of the seed-vessel, with a slender awn projecting a little farther, clearly distinguishes the seed from that of the *Holcus*, or soft-grass, (No. X.)

XII.

MELICA cœrulea.

Purple Melic-*grass.*

The seed is covered by the inner husk until it be perfected; afterwards it encloses it loosely. The body of the seed is oval-oblong, and a little incurved.

XIII.

POA compressa.

Flat-stalked Meadow-*grass.*

The seed is covered with the inner husks, without opening; it is oblong, flattened, and tapers to a point at each end.

XIV.

BRIZA media.

Common Quaking-*grass.*

The inner husks enclose the seed unchanged till ripe; it is roundish, and very small: the hollow, or concave form of the husks, with their shining membraneous appearance, peculiarly distinguish the seeds of this genus.

XV.

DACTYLIS glomerata.

Round-headed Cock's-foot *grass.*

The husks of the blossom enclose the seed until it is ripe; it is oblong, and furrowed on one side.

XVI.

CYNOSURUS cristatus.

Crested Dog's-tail *grass.*

The seed is covered with the inner husks, which do not open; it is oblong, and pointed at each end.

XVII.

FESTUCA pratensis.

Meadow Fescue-*grass.*

The husks of the corolla envelopes the seed, and adhere to it without opening: it is oblong, slender, and very acute; rounded on one side, and marked with a longitudinal furrow on the other.

XVIII.

BROMUS mollis.

Soft Brome-*grass*.

The inner husks, or corolla, shut close upon, and adhere to the seed, which is oblong, convex on one side, and furrowed on the other.

XIX.

STIPA pinnata.

Long-awned Feather-*grass*.

The seed is covered by the inner husks; it is oblong.

XX.

AVENA pubescens.

Downy Oat-*grass*.

The seed is covered with the husks of the blossom; it is slender, oblong, and tapers to a point at each end, marked with a furrow lengthwise. The seed of the different species of fescue, brome, and oat-grasses, are very much alike at the first glance; nevertheless, they offer sufficient marks of distinction, provided a little minuteness in the examination be employed by the Agriculturist. Thus the seed of the fescue terminates in an acute point; that of the brome-grass is blunt or obtuse: if a species of the former be awned, the awn is a continuation of the husk; but the awn of a brome-grass is inserted *below* the apex of the husk, and surrounded at the base with its membraneous edges;—but more of this hereafter.

XXI.

ARUNDO epigejos.

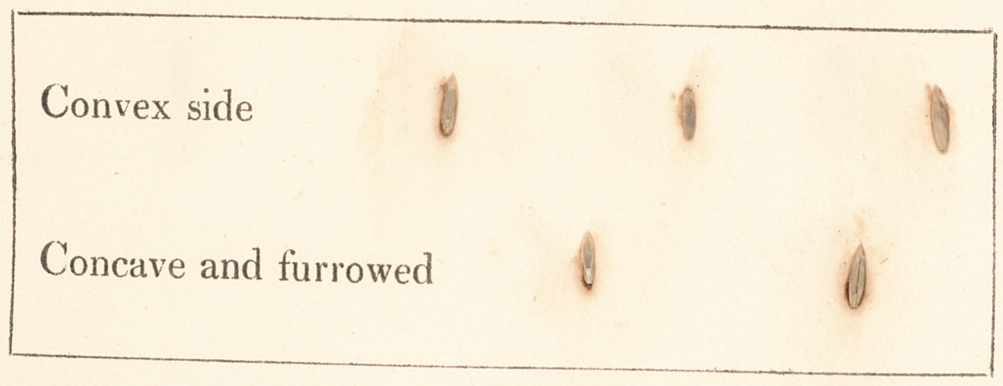
Wood Reed-*grass.*

The inner husks adhere to the seed, without opening; the naked seed is oblong, and pointed at both ends: it is furnished at the base with downy hairs. The hairs give this seed at first the appearance of that of the cotton-grass, *eriophorum*, (No. III.); but on removing the hairs, the body of the seed of the cotton-grasses is three-cornered, while that of the reed-grasses is oblong and pointed.

XXII.

LOLIUM perenne.

Perennial Rye-*grass.*



The inner husks enclose the seed, which is oblong, compressed; convex on one side, and flat, with a furrow lengthwise, on the other.

XXIII.

ELYMUS geniculatus.

Jointed Lyme-*grass.*

The husks of the blossom adhere to the seed, which is convex on one side, and strap-shaped, (*linearis*).

XXIV.

HORDEUM *murinum.*

Wall Barley-*grass.*

The husks cover the seed without opening; it is oblong, bellying, angular, tapering at each end, and furrowed.

XXV.

TRITICUM *repens.*

Creeping-rooted, Wheat, or Couch-*grass.*

The husks of the blossom enclose the seed until it is perfected, and afterwards open, and emit it: the seed is oval-oblong and obtuse at both ends; on this side convex, on the other furrowed.

The utility of a thorough acquaintance with the foregoing principal characters of distinction, or the generic characters of the seeds of grasses, will best appear by practically applying them to distinguish those seeds from each other that are found to have the nearest resemblance, but producing plants of different species; and likewise the seeds of such grasses as are of more importance for the Agriculturist to distinguish from all others.

XXVI.

PHALARIS arundinacea.

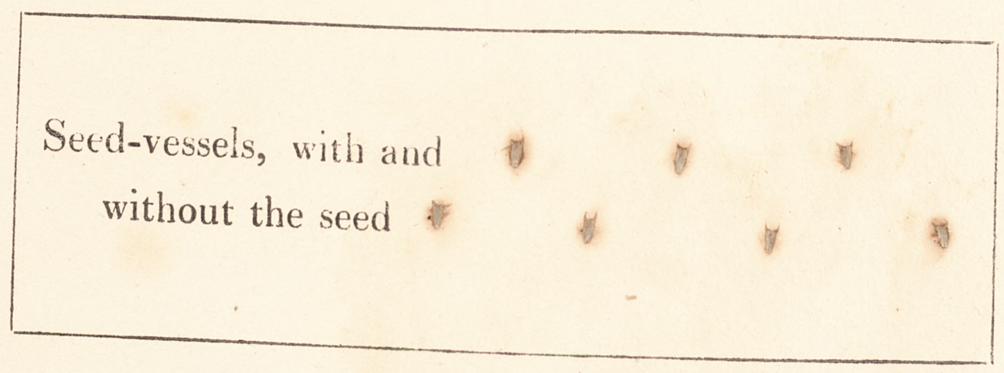
Reed-like Canary-*grass.*

The above seed is somewhat cylindrical; the microscope also shews it to be furnished with hairs at the base, and it is covered by the husks of the corolla; so far, therefore, it resembles the *Arundines,* (No. XXI). However, the hairs of the arundo encircle the base of the seed; but in this seed they are divided into two distinct tufts, situated on opposite sides of the base of the seed. But what seems to determine the alliance at first sight between this grass and the *Phalaris,* is its shining, horny crust, (see No. IV). That of the arundo is membraneous, or scale-like; it is sharp-pointed at each end, but that only tapers to a blunt point. The nutritive matter afforded by this grass, has qualities more analogous to that of the different species of *Phalaris,* than to that of the *Arundines*; I therefore follow Schrader, in ranking it with the *Phalarides**.

XXVII.

PHLEUM pratense. Var. *minor.*

Lesser Variety of Meadow Cat's-tail *grass.*



This seed, of a very inferior variety of meadow cat's-tail, is distinguished from that of the true variety, or Timothy-grass, in being one-third smaller, of a rounder form, and the dagger-points, or fork of the seed-vessel, shorter, and bent rather outwards; while those of the true variety are nearly straight, or inclined inwards; which will appear manifest on referring to No. V.

* "Corolla duplici et semine corolla interiori corticato nostrum gramen a Phalaridis genere haud commode disjungitur. Pili, corollam Arundinum cingentes, proprie desunt; nec semen, ut in illo genere, librum et corolla membranacea tectum, sed corolla cartilaginea corticatum. Neque etiam ulla nos necessitas cogit, ut illud pro distincto genere habeamus."

Schrader. "Flora Germanica," Vol. I. p. 182.

XXVIII.

ALOPECURUS agrestis.

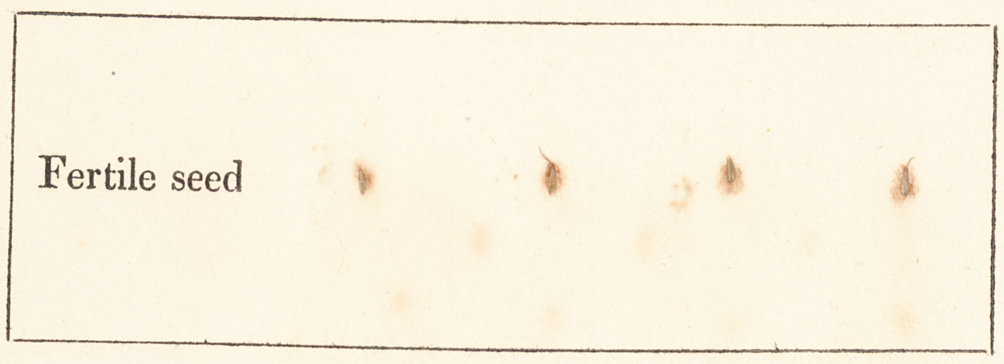
Slender Fox-tail *grass.* (Annual).

Here we have a seed which is covered with the husks of the corolla, the larger valve of which is furnished with an awn. On referring to No. VII. we find this to be the generic character of the fox-tail grass, *(Alopecurus)*, and that it differs from the seed of that species, *(Alopecurus pratensis*, or perennial meadow fox-tail), in being smoother, and naked, or wanting the downy hairs which clothe the surface of the former: this may be perceived by the naked eye, or even sufficiently by the touch. On passing some seeds between the fingers, that of the meadow, or perennial fox-tail, will be found quite soft; but that of the slender, or annual species, (shewn above), hard and unpleasant.

XXIX.

HOLCUS mollis.

Creeping-rooted, or soft Couch-*grass.*



The plant that produces this seed, is one of the most troublesome weeds, or couch-grasses, that infest light dry soils. The near resemblance which it bears to the woolly soft-grass, *(Holcus lanatus)*, causes it often to be confounded with that grass. The seeds are readily distinguished at the first view; those of the *lanatus*, (see No. X.), are covered with woolly hairs, and loosely envelope the seed with the husks. But the seed of the *Mollis*, as seen above, is perfectly smooth, and shining.

XXX.

AIRA flexuosa.

Zig-zag Hair-*grass.*

The seed of this grass is introduced here, not because it possesses any very valuable properties, or the reverse, but that, as it is very common on sandy soils, it may be carefully distinguished from the seed of hassock-grass, (No. XI.), which is so unprofitable, and difficult to eradicate when once in possession of the soil, that some have applied to it the epithet execrable. The above seed differs from that of the hassocks, (No. XI.), in being one half larger in the awn, which is long, of a dark colour, and recurved, or bent back a little, before it reaches the top of the seed; the form of the seed is likewise more of an oblong figure, which a reference to No. XI. will shew.

XXXI.

POA pratensis.

Smooth-stalked, or creeping-rooted Meadow Couch-*grass.*

XXXII.

POA trivialis.

Rough-stalked, or common Meadow-*grass.*

The *Poa pratensis* has a strong creeping root, and, like every other creeping-rooted plant, is a great impoverisher of the soil, and with difficulty rooted out of land: the *Poa trivialis* has

many good qualities; it is therefore of importance to distinguish their seeds, which are so much alike. The chief mark of distinction to the naked eye, is the woolly web which connects or entangles the seeds; in the *P. pratensis* it is greater than in the *P. trivialis;* the seeds of the former can hardly be separated from each other, but those of the *P. trivialis* are very little entangled by the web. But with the aid of a glass, they may be determined with more certainty: the seed of the *P. pratensis* being more acuminate, and appearing on the face concave; while that of the *P. trivialis* is shorter, rounder, and nearly quite flat on the face. See No. XIII. *pro char. gener.*

XXXIII.

FESTUCA elatior.

Tall Fescue-*grass.*

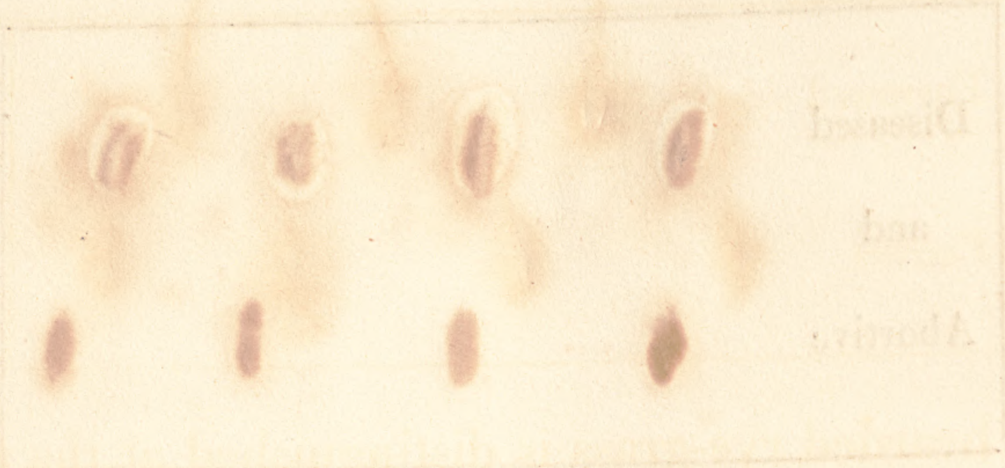
The seed of this grass is always either diseased or abortive, as shewn in the above specimens. The form of the seed-vessel, or abortive seed, is scarcely to be distinguished from that of the *Festuca pratensis,* (No. XVII.), but may be distinguished with certainty by passing it between the fingers: it feels like a mere husk; and the diseased seed may be perceived by the eye. On comparing the above specimens with those of the *Festuca pratensis,* (No. XVII.), the seed-vessel appears more elongated and compressed, which evidently arises from the absence of the body of the seed. The seed of the *Festuca pratensis* appears to be always free from disease.

XXXIV.

BROMUS arvensis.

Field, or Corn Brome-*grass.*

This seed is distinguished from that of *Bromus mollis,* by being longer, more slender, and being sharp-pointed. This is one of the best of the annual brome grasses, as will be shewn hereafter, and it is therefore of importance that its seed should be known from that of the *Bromus mollis,* a very troublesome weed.



XXXV.

LOLIUM temulentum.

Annual bearded Rye-*grass.*

The seed of the annual bearded rye-grass is distinguished at the first sight from that of the perennial rye-grass, (No. XVII.), by its long awn; the body of the seed is likewise more swoln, shorter, less convex on the back, and the furrow on the face of the seed broader. This seed, when mixed with other grain, and made into bread, is said to be deleterious. Professor Martyn supposes this grass to be the darnel of the Romans.

" ——————Interque nitentia culta
" Infelix lolium et steriles dominantur avenæ." *Virg. Georg.* I. 153.

It remains, now, only to shew how effectually the mode of arranging grasses into genera, species, and varieties, assists the memory; and particularly of those, whose purpose here, is only to render more certain and easy the means usually employed to obtain a just knowledge of the properties, or comparative merits of the different grasses.

Every species of grass, properly so called, is distinguished from all other plants by the following peculiar structure: The stem, or straw, is hollow, and jointed; the leaves are long, slender, and entire, sheathing or investing the straw for some length, and in number equal to the joints of the straw; the flower consists of one, or two membranaceous husks, which bears but one seed, and the seed has only one lobe, or seed-leaf. Every plant, therefore, that possesses all these peculiarities of structure, is a proper species of grass; hence the proper grasses are called a natural order of plants.

But besides this agreement of external structure, grasses are distinguished from other natural orders of plants by this property, that every part of the plant becomes food for the larger and more valuable domestic animals. Other natural orders of plants afford only the fruit, or seed, or perhaps the root; others again are poisonous: it follows, that the properties of plants, when distinctly known, may be included with advantage in their natural characters of distinction.

All the species which compose this family, may also be distinguished from each other by the difference in the qualities of the nutritive matter which each affords. Those species which have the greatest affinity to each other in external form, likewise contain nutritive matters, that differ less from each other in their sensible qualities or composition, than those of the species which are more dissimilar in their external figure. However circumscribed the knowledge of this connection may be, which seems to exist between the external forms and nutritive products of

grasses, still, if certain external characters should be found to indicate peculiar nutritive qualities, the botanical description of any species of grass would not only convey a knowledge of its external form, but likewise an idea of its value, as an article of food. That this would be productive of much practical utility, can hardly be doubted; and the following particulars, stated from the results of attentive observation, and numerous comparisons made in the course of the experiments, and which gave occasion for the above remarks, may at least shew, that the subject is worthy of further investigation.

1st, Grasses which have culms with swoln joints, leaves thick and succulent, and flowers with downy husks, contain greater proportions of sugar and mucilage.

2nd, When this structure is of a light glaucous colour, the sugar is generally in excess.

3rd, Grasses which have culms with small joints, flowers pointed, collected into a spike, or spike-like panicle; leaves thin, flat, rough, and of a light green colour; contain a greater proportion of extractive matter.

4th, Grasses which have culms furnished with numerous joints, leaves smooth and succulent, flowers in a spike or close panicle, florets blunt, and large, contain most gluten and mucilage.

5th, When this structure is of a glaucous colour, and the florets woolly, sugar is in the next proportion to mucilage, (No. II).

6th, Grasses which have their flowers in a panicle, florets pointed or awned, joints of the culm smooth, sheaths of the leaves hairy, leaves smooth and succulent, contain most mucilage and extractive.

7th, Grasses with flowers in a panicle, florets thinly scattered, pointed, or furnished with long awns, culms lofty, with few joints, leaves flat and rough, contain a greater proportion of saline matter and bitter extractive.

8th, Grasses with strong creeping roots, culms few, leaves flat and rough, flower in a spike, contain a greater proportion of bitter extract, with mucilage.

The above general description of the figure, and properties of grasses, considers every part of the plant, and is therefore termed the natural character of grasses.

The simplicity of form which runs through the whole structure of this order of plants, can admit of but few very obvious variations to distinguish the different species from each other; which indeed appears in the foregoing enumeration of terms that represent them.

The parts of fructification, the flower, and the seed, are the least liable to vary from any change of soil or cultivation, and Botanists have chosen them on that account, to fix their generic distinctions; or when the flowers and seeds of any number of grasses agree in one or two particular points, and differ therein from all the rest, such are termed a genera or family. The difference in the manner of inflorescence, and the form of clothing of the culm, leaves, and roots, afford the specific characters, or separate the genera into species: when the difference between two grasses amounts to little else than one or two of these last-mentioned points, or when such distinctions are either lost or found by raising the plant from seed, it is then considered a variety*. These characters of genera, species, and varieties, being founded on a few

* When a variety retains those marks of distinction after being raised from seed, it is called a permanent variety; when it loses those distinctions, it is then styled an accidental variety.

parts only, and those frequently not very obvious, have been termed artificial characters of distinction. The memory, by these means, is relieved from a multiplicity of minute distinctions, which would not be the case were all the parts of the plant included in the essential specific description or character.

Though most of the genera are considered as merely artificial, yet there are several which have their nutritive matters of a description peculiar to themselves. Sir Humphry Davy informs us, that the nutritive matters from the different species of fescue, in general, afford more bitter extractive matter than those from the different species of poa, and that the seed crop of the *Phleum pratense* afforded more sugar than any of the poa or festuca species.

M. St. Hilaire, in his Exposition of the Natural Families of Plants*, arranges grasses according to the number of the styles, the stamina, and the number of florets contained in each calyx. Accordingly he divides grasses into ten sections.

Sect. I. Contains such grasses as have 2 styles, and 1, or 2 stamina.

II. Grasses which have 2 styles, 3 stamina, and the calyx 1-flowered.

III. Grasses furnished with 2 styles, 3 stamina, calyx containing two flowers, one of which consists of stamina only.

IV. Grasses which have 2 styles, 3 stamina, calyx 2, or 3-flowered, the flowers of different sexes.

V. Consists of grasses which have 2 styles, 3 stamina, calyx 1, or 2-flowered, all the flowers bisexual.

VI. Grasses furnished with 2 styles, 3 stamina, calyx many-flowered, flowers glomerated.

VII. Grasses with 2 styles, 3 stamina, calyx many-flowered, flowers in a spike, or situated on the axils of the stalk, terminating floret male, or barren.

VIII. Contains the grasses which have 2 styles, 3 stamina, and calyx many-flowered.

IX. Grasses with 2 styles, and 6, or more stamina.

X. Grasses which have their style unique, summit simple, and 3 stamina.

From the great simplicity of the above natural system, its merits are obvious; yet, like all others that have been framed, it is in some degree imperfect, as there are several species which possess characters that entitle them to a place in more than one section. For practical purposes, therefore, an arrangement which partakes of what is called the natural character, as well as the artificial, has been found most useful, as may appear by the following general catalogue of grasses so arranged.

* Exposition des Familles Naturelles, et de la Germination des Plantes, par Jaume St. Hilaire. Paris, 1805.

Sect. I. *Grasses with 2 Stamina, 2 Styles, Calyx containing 1 Flower.*

ANTHOXANTHUM. Vernal-grass. Generic character: calyx, husk of 2 valves, containing 1 flower. Blossom or corolla, husk 2 valves, tapering to a point. Seed-vessel, the husks of the corolla adhere to the seed. Seed nearly cylindrical, tapering at each end.

odoratum, per. sweet-scented vernal-grass, indig. Flowers in April and May. E. Bot. 647.
amærum, per. bitter; nat. Morocco, introduced . Flowers in May.

Sect. II. *Grasses with 2 Stamina, 1 Style, and the Calyx 1-flowered.*

NARDUS. Mat-grass. Generic character: corolla 2-valved, calyx wanting. Seed, linear, oblong.

stricta, per. upright mat-grass, indig. Flowers in June and July. E. Bot. 290.
filiformis, ann. slender mat-grass; nat. Portugal. Flowers in June.
aristata, ann. See *Rottboellia monandra.*

ERIOPHORUM. Cotton-grass. Generic character: calyx, 1 valve, 1-flowered; flowers in an imbricated spike, exterior flower generally barren. Corolla, wanting, if the calyx valve be not considered such. Seed three-cornered, furnished with downy hairs.

alpinum, per. alpine cotton-grass, indig. Flowers in April and May. E. Bot. 311.
vaginatum, per. sheathed cotton-grass, indig. Flowers in April and June. E. Bot. 873.
capitatum, per. headed cotton-grass, indig. Flowers in June and July. E. Bot. 2387.
triquetrum, per. three-cornered cotton-grass; nat. Germany. Flowers in May. Flo. Ger. i. 152.
angustifolium, per. narrow-leaved cotton-grass, indig. April and May. E. Polystachion. Curt. E. Bot. 564.
latifolium, per. broad-leaved, indig. May. E. Bot. 563. E. Polystachion.
gracile, per. slender, indig. May. E. Bot. 2042.

Sect. III. *Grasses with 3 Stamina, 2 Styles, 1 Flower in each Calyx; Flowers bisexual, corolla of 1 Valve only.*

TRICHODIUM. Single-husked bent. Generic character: calyx 2-valved, corolla 1 valve, smaller than the calyx, awned or awnless, furnished with a tuft of hairs on one side of its base. Seed covered by the husk.

caninum, per. brown, indig. July. *Agrostis canina.* Flo. Britan. i. p. 78.
niveum, per. snowy, indig. June. *Agrostis nivea*, Don.—Var. *T. caninum.* Flo. Ger.
muticum, per. awnless, indig. July. Flo. Ger. Var. *T. caninum*, f. "*floribus muticis.*"
alpinum, per. alpine; nat. Germ. July. Flo. Ger. i. 200.
rupestre, per. rock, indig. June. *Agrostis stricta*, Don. *T. rupestre*, Flo. Ger.

ALOPECURUS. Fox-tail grass. Generic character: calyx, 2-valved, 1-flowered, valves united at the base. Blossom 1 valve, with an awn proceeding from the base.

pratensis, per. meadow fox-tail, indig. May. Eng. Bot. 759.
geniculatus, per. jointed, indig. June. E. Bot. 1250.
var. *bulbosus*, per. bulbous-jointed. June. Wither. Arr.
bulbosus, per. upright bulbous-rooted, indig. June. E. Bot. 1249.
fulvus, tawny-coloured, indig. E. Bot. 1467.
alpinus, per. alpine, indig. April and May. E. Bot. 1126.
agrestis, ann. slender, indig. June and July. E. Bot. 848. *A. myosuroides*, Curtis.
utriculatus, ann. inflated; nat. Germ. Flowers in May and June. Flo. Ger. i. 174.
paniceus, ann. hairy, indig. Wither. Arr. ii. 121. Flowers in July. Bloss. 2 valves.

KNAPPIA. Knapp's grass. Geneneric character: calyx 1-flowered, 2-valved, truncated. Corolla like hairs, united at the base, parallel, enclosing the fructification.

agrostidea, ann. bent like Knapp's grass, indig. May. E. Bot. 1127.

SECT. IV. *Grasses with 3 Stamina, 2 Styles; Calyx 1-flowered, bisexual, Corolla 2 Valves.*

SYNTHERISMA. *syntherisma.* Generic character: calyx 1-flowered, 3-valved, pressed close to the corolla, unequal, third valve smallest. Corolla, exterior valve convex; interior flattish, embracing the other. Seed covered by the husks of the corolla as with a crust.

ciliare, ann. hairy syntherisma; nat. Ger. July. *Panicum ciliare,* Willd. i. 346.

vulgare, ann. common, indig. August. *Panicum sanguinale,* E. Bot. 849.

glabrum, ann. smooth; nat. Germ. August. Flo. Ger. i. 163. *Pan. sanguinale,* Leers. Herb.

DIGITARIA. Finger-grass. Generic character: calyx 2-valved, unequal, spreading. Corolla, 2 valves, larger than the calyx, compressed, valves nearly of the same length, interior very narrow, included in the larger or exterior husk. Seed covered as with a crust.

stolonifera, per. creeping, indig. August. *Panicum dactylum,* E. Bot. 850.

CRYPSIS. *crypsis.* Generic character: calyx 2-valved, 1-flowered, compressed, unequal. Corolla 2-valved; interior longer than the calyx; exterior valve shorter than the calyx. Seed covered by the corolla, somewhat columnar.

alopecurioides, ann. foxtail-like crypsis; nat. Germ. August. Flo. Ger. i. 167; Host. i. 23. *H. alopecurioides.*

schoenoides, ann. rush-like; nat. Germ. July. Flo. Ger. i. 168. *Heleochloa schoenoides,* Host. t. 30.

aculeata, ann. prickly crypsis; nat. Germ. Host. t. 31.

PHALARIS. Canary-grass. Generic character: calyx 2-valved, and double, 1-flowered; valves nearly equal, larger than the corolla. Corolla 2 valves, enclosed in the calyx. Seed ovate-oblong, covered by the corolla like a crust.

canariensis, ann. canary-grass, indig. August. E. Bot. 1310.

aquatica, ann. water canary-grass; nat. Germ. May and June. Host. t. 39.

arundinacea, per. sea-mat weed, indig. E. Bot. 402. June and July. Var. *colorata. Arundo colorata.* Hort. Kew. i. 147.

paradoxa, ann. black bristle-spiked; nat. Germ. May, June. Host. t. 40.

arenaria, ann. sea canary-grass, indig. June, July. Eng. Bot. 222; Flo. Ger. *Phleum arenarium,* i. p. 189.

bulbosa, per. bulbous-rooted; nat. Barbary. August. Linn. Spec. 79.

nodosa, per. knobbed-rooted; nat. south of Europe. Willd. 327.

dentata, tooth-keeled; nat. Cape of Good Hope. Linn. Suppl.

paniculata, per. panicled canary-grass, indig. July. E. Bot. 1077. Flo. Ger. *Phleum asperum.*

utriculata, ann. Linn. See *Alopecurus utriculatus.*

PHLEUM. Cat's-tail grass. Generic character: calyx 2-valved, sitting, strap-shaped, lopped, ending in two dagger points, enclosing the blossom. Corolla 2-valved, awnless, simple. Seed loosely covered with the husks of the corolla.

pratense, per. meadow cat's-tail grass, indig. June, July. Eng. Bot. 1076.

var. *minus,* per. lesser meadow cat's-tail, indig. July, August. See our specimen.

nodosum, per. jointed, or bulbous-stalked, indig. August. Flo. Dan. 380.

alpinum, per. alpine cat's-tail grass, indig. June. E. Bot. 519.

paniculatum, per. See *Phalaris paniculata.*

asperum, per. Flo. Ger. See *Phalaris paniculata.*

arenarium, ann. See *Phalaris arenaria.*

PHLEUM. *boehmeri*, per. canary-like cat's-tail grass, indig. June, July. E. Bot. 459. *Phalaris phleoides.*
Michelii, per. smooth, indig. June. E. Bot. 2265. Host. *Phalaris alpina.*
Gerardi, per. Gerard's cat's-tail grass; nat. Ger. June. Flo. Ger. i. 190.
tenue, ann. slender; nat. Ger. May. Host. t. 35, *Phalaris tenuis.*
crinitum, ann. bearded, indig. July. Dr. Smith, Flo. Britan. i. p. 171.

MILIUM. Millet-grass. Generic character: calyx 2-valved, 1-flowered, valves nearly equal, ventricose. Corolla 2-valved, enclosed in the calyx, larger valve awned. Seed covered with the corolla.
paradoxum, per. black-seeded millet; nat. Germ. July. Flo. Ger. i. p. 196.
effusum, per. common wood millet, indig. E. Bot. 1106. Flowers in May and June.
lendigerum, ann. yellow millet, indig. May and June. E. Bot. 1107.
Capense, per. Cape millet; nat. Cape of Good Hope. Linn. Syst. 109.
punctatum, per. dotted millet; nat. Jamaica. Willd. Spec. Plant. i. p. 359.
confertum, per. clustered; nat. Germ. June. Ibid. i. 360.
globosum, per. globular; nat. Japan. June. Ibid. i. 360.

AGROSTIS. Bent-grass. Generic character: calyx 1-flowered, 2-valved, spear-shaped, acute, generally rough on the keel, longer than the blossom. Corolla 2-valved; summits of the styles hairy. Seed loosely covered by the corolla husks.
spica-venti, ann. silky bent-grass, indig. June and August. E. Bot. 951.
palustris, per. marsh bent-grass, indig. July, August. Wither. Arr. ii. p. 126.
canina, per. brown bent, indig. July. Wither. Arr. ii. p. 126. Var. *A. vulgaris.* Dr. Smith, l. c.
canina, per. Dr. Smith, Flo. Britan. i. p. 78. See *Trichodium caninum.*
vinealis, per. slender trailing bent, indig. July, September. Wither. Arr. ii. p. 127. Flo. Ger. Var. *Alba*, i. 209.
pallida, per. pale bent, indig. May and June. Wither. Arr. i. p. 127; Flo. Ger. i. p. 198. Var. *Trichod. caninum.*
alpina, per. alpine bent, Wither. Arr.; indig. See *Trichodium alpinum.*
littoralis, per. sea-side bent, Wither. Arr. i. p. 128; indig. June.
interrupta, per. interrupted spiked bent; nat. Germ. July. Flo. Ger. i. 204.
pauciflora, per. small flowered; nat. Germ. July. Flo. Ger. i. p. 205.
miliacea, per. millet bent; nat. Spain. July, August, Willd. Spec. Plant. i. 365.
setacea, per. bristly bent, indig. July. E. Bot. 1188.
repens, per. creeping rooted, indig. August. Wither. Arr. ii. p. 130, *A. nigra.*
alba, per. white bent, indig. August, September. E. Bot. 1189.
stolonifera, per. stoloniferous bent. indig. July, September. E. Bot. 1532.
var. *angustifolia*, per. smaller-leaved stoloniferous bent. See our specimen.
var. *latifolia vel Richardsonia*, fiorin. See our specimen.
fascicularis, per. tufted-leaved bent, indig. June, July. Curtis.
vulgaris, per. common bent, indig. June, July. E. Bot. 1671.
lobata, per. lobed panicled, bent, indig. July. Curtis. See our specimen.
Mexicana, per. Mexican bent-grass; nat. Mexico. Sept. Hort. Kew. i. p. 150.
var. *ramosissima*, branching Mexican bent. See our specimen.

ARUNDO. Reed-grass. Generic character: calyx 1-flowered, seldom many-flowered, 2-valved, flowers erect. Corolla 2-valved, acuminate, surrounded at the base with downy hairs. Seed loosely enclosed by the corolla husks.
epigejos, per. wood reed-grass, indig. July. E. Bot. 402.
litorea, per. sea-side; nat. Germ. July. Flo. Ger. i. 212.
pseudophragmites, per. false reed; nat. Germ. July. Flo. Ger. i. 213.

ARUNDO. *calamagrostis*, per. bent-like reed, indig. July. E. Bot. 403.
stricta, per. upright reed, indig. June to August. E. Bot. 2160.
arundinacea. See *Phalaris arundinacea*.
var. *colorata*. See *Phalaris arundinacea*.
varia. per. various-panicled reed; nat. Germ. June to August. Flo. Ger. i. 216.
acutiflora, per. acute-flowered; nat. Germ. June. Flo. Ger. i. p. 217.
sylvatica, per. Calmuc reed; nat. Germ. June, July. Flo. Ger. i. p. 218.
speciosa, per. elegant reed; nat. Germ. July, August. Flo. Ger. i. p. 219.
tenella, per. small reed; nat. Germ. July. Flo. Ger. i. p. 220.
arenaria, per. sand reed, indig. July and August. E. Bot. 520.
Baltica, per. Baltic sea-reed; nat. Germ. July. Flo. Ger. i. p. 223.

The following Species contain more than 1 Flower in each Calyx, and are an exception to this Arrangement.

phragmites, per. common, indig. August. Eng. Bot. 401.
donax, per. cultivated; nat. South of Europe. Moris. Hist. sect. 8, t. 8.
conspicua, per. showy; nat. New Zealand. G. Forster, Ter. Australis, n. 48.

SACHARUM. Sugar-grass. Generic character: calyx 2-valved, 1-flowered, furnished or clothed with long silky hairs. Corolla 2 valves. Seed invested by the husks of the corolla.
cylindricum, per. cylindric sugar-grass; nat. Germ. Summer. Flo. Ger. i. p. 226. Moris. sect. 8, t. 4, f. 4.
Ravennæ, per. Italian; nat. Italy. July and August. Linn. Syst. 103.

LAGURUS. Hare's-tail grass. Generic character: calyx 2 valves, 1-flowered, each valve ending in a villose awn. Corolla 2 valves, the exterior valve having three awns; the middle awn, from the back of the valve, bent and twisted. Seed covered, awned.
ovatus, ann. oval-spiked hare's-tail grass, indig. July. E. Bot. 1334.

STIPA. Feather-grass. Generic character: calyx 2-valved, 1-flowered. Corolla 2 valves, the exterior valve furnished with a long awn, which is jointed at the base. Seed oblong, covered.
pennata, per. soft feather-grass, indig. June. E. Bot. 1356.
capillata, per. capillary; nat. Germ. June. Flo. Ger. i. p. 231.
juncea, per. rush-leaved; nat. France. July. Hort. Kew. i. p. 170.
aristella, per. short-awned; nat. France. July. Willd. ii. p. 441.
tenacissima, per. tough; nat. Spain. August. Willd. ii. p. 442.

LAPPAGO. *lappago*. Generic character: calyx 3-valved. Corolla 2-valved, valves inverse, or resupine. Seed covered loosely by the corolla.
racemosa, branching lappago; nat. South of Europe. August. Hort. Kew. i. 182.

ROTTBOELLIA. Hard grass. Generic character: spike-stalk, or rachis, jointed, roundish. Calyx 1 or 2-valved, lateral, containing 1 or 2 flowers; flowers alternate, on a zig-zag footstalk. Seed covered by the blossom.
incurvata, ann. sea hard-grass, indig. Flowers in June. E. Bot. 760.
monandra, ann. single hard-grass; nat. Germ. May and June. Flo. Ger. i. 411. *Nardus aristata*, (Willd.)

LEERSIA. Leer's grass. Generic character: calyx wanting. Corolla 2-valved, 1-flowered, shut. Seed oval, compressed.
oryzoides, per. rice-like; nat. Germ. Flowers in August and September. Host. t. 35.
(Melica ciliata et uniflora excipiuntur).

Sect. V. *Grasses with 3 Stamina, 2 Styles, 1 Flower in every Calyx—Flowers of different Sexes.*

ANDROPOGON. *andropogon.* Generic character: calyx 2-valved, 1-flowered; outer valve embracing the inner, cartilaginous. Corolla 2-valved, awned; male flowers on foot-stalks, single, or in pairs to each female flower. Seed oblong, covered with the blossom.

distachyum, per. two-rowed andropogon; nat. Germ. Flowers in June and July. Flo. Ger. i. 232.
ischæmum, per. woolly-spiked; nat. Germ. Flowers in August. Host. t. 3.
Gryllus, per. purple-spiked; nat. Germ. July to August. Host. t. 1.
arundinaceum, per. reed-like; nat. Germ. June and July. Host. i. t. 1. *Holcus halepensis.*
Schænanthus, per. sweet-lemon grass; nat. East Indies. Linn. Spec. 1481. Not yet flowered in this country.

HORDEUM. Barley-grass. Generic character: calyx lateral, 6-valved, (the valves, collectively, constitute what is called a six-leaved involucre). Corolla 2-valved; exterior valve furnished with a long awn. Flowers in threes, the middle flower fertile or bisexual, and the lateral ones barren, or furnished with stamens only. Seed covered closely with the corolla, which remains permanent.

vulgare, ann. spring barley; supposed to be a native of Sicily. August. Flo. Rust. 20.
hexastichon, ann. bear, or big. Flo. Rust. 107. August.
distichon, ann. common or winter barley. August.
murinum, ann. wall-barley, or way-bennet, indig. E. Bot. 1971.
maritimum, ann. sea barley-grass, indig. May. E. Bot. 1205.
jubatum, ann. long-bearded; nat. North America. August. Hort. Kew. i. p. 180.
zeocriton, ann. sprat, or battledore barley. August, Host. t. 37.
bulbosum, per. bulbous-rooted barley. Flo. Græca, t. 98; nat. Italy. June and July.
pratense, per. meadow barley, indig. June. E. Bot. 409.

Sect. VI. *Grasses with 3 Stamina, 2 Styles; 2 Flowers in each Calyx—Flowers bisexual.*

AIRA. Hair-grass. Generic character: calyx 2-valved, 2-flowered, without any rudiment of a third floret. Corolla 2-valved; outer valve awned; the awn rising from the back, a little above the base; seldom awnless. Seed loosely covered.

aquatica, per. water hair-grass, indig. June, July. E. Bot. 1557.
cristata, per. crested hair-grass, indig. June. E. Bot. 648.
arundinacea, per. reed-like hair-grass; nat. Levant. Linn. 95.
cæspitosa, per. turfy hair-grass, hassock-grass, indig. July. E. Bot. 1453.
flexuosa, per. zig-zag mountain hair-grass, indig. June. E. Bot. 1519.
caryophyllea, ann. silver, indig. May. E. Bot. 812.
præcox, ann. early, indig. April. E. Bot. 1296.
canescens, per. grey, indig. June. E. Bot. 1190.
subspicata, per. spiked hair-grass; nat. Germ. June. Host. t. 45.
antartica, per. South-Sea hair-grass; nat. New Zealand. G. Forster, Flo. Aus. 41.
involucrata, per. involucred; nat. Spain. Cavenill. Hisp. t. 44, f. 1.

MELICA. Melic-grass. Generic character: calyx 2-valved, 2-flowered, with the rudiment of 1, or 2 florets, that are abortive, and placed between the others. Corolla 2-valved, awnless. Seed ovate, grooved.

ciliata, per. ciliated; nat. Germ. May and June. Host. t. 12.
nutans, per. nodding, indig. May. E. Bot. 1059.
uniflora, per. one-flowered, indig. May and June. E. Bot. 1058.
cærulea, per. purple, indig. July and August. E. Bot. 750.

MELICA. *minuta,* per. small; nat. Italy. June. Willd. Syst. 383, 119.
altissima, per. tall; nat. Siberia. Aug. Host. t. 9.
(*Cynosurus echinatus, Sesleria, et Avanæ*).

SECALE. Rie, or rye-grass. Calyx 2-valved, 2-flowered, solitary. Corolla 2-valved, 2-flowered; exterior valve acuminate, keel ciliated, ending in a long awn; interior valve flat, lanceolate. Seed naked, half cylindrical, pointed at one end.
cereale, ann. Rie. Moris. Hist. v. 3, 58, t. 2, f. 1. Supposed a native of Crete or Siberia.
villosum, ann. hairy; nat. South of Europe and Levant. Host. ii. t. 48.
orientale, ann. oriental; nat. of the Archipelago. Willd. i. p. 171.
Creticum, ann. Cretan; nat. of Candia, or Crete. Willd. i. p. 472.

SECT. VII. *Grasses with 3 Stamina, 2 Styles, 2 Flowers in each Calyx.—Flowers of different Sexes.*

HOLCUS. Soft grass. Generic character: calyx 2-valved, 2-flowered, seldom 3; awnless. Corolla 2-valved; exterior valve awned; interior valve awnless, least; unisexual, or barren flowers, on footstalks; they also want the inner husks. Seed ovate, awned.
avenaceus, per. tall oat-like soft grass, indig. June till October. E. Bot. 813. Curtis, Flora, *Avena elatior.*
var. *bulbosus,* per. bulbous-rooted, indig. June till October. Moris. Hist. sect. 8, t. 7, f. 38.
var. *muticus,* per. awnless tall oat-like soft grass. Curt. Cat. *Poa elatior.*
mollis, per. downy, or creeping-rooted, indig. July. E. Bot. 1170.
lanatus, per. woolly, indig. June. E. Bot. 1169.
striatus, per. striated; nat. Virginia. Lin. Spec. 1486.
spicatus, ann. spiked; nat. East Indies. Linn. Spec. 1483.
Sorghum, ann. cultivated, or Indian Millet. Linn. Spec. 1484.
odoratus, per. sweet-scented; nat. Germ. April, May. Host. t. 4. *Holc. australis,* Flo. Ger. i. 253.
var. *repens,* per. creeping-rooted; nat. Germ. *Holc. borealis,* Flo. Ger. i. 252.
redolens, per. smelling; nat. New Zealand. Vahl. Sy. ii. 102.
latifolius, ann. broad-leaved; nat. China. Linn. Spec. 1486.

PANICUM. Panic-grass. Generic character: flowers polygamious. Calyx 2-valved, 2-flowered; one fertile, or bisexual, and the other barren, or neuter. Corolla 2-valved, awnless, or awned at the apex; neuter floret of 1 or 2 valves. Seed covered like a crust.
verticillatum, ann. whorle-flowered, indig. July. E. Bot. 874.
viride, ann. green, indig. July and August. E. Bot. 875.
glaucum, ann. glaucous; nat. Germ. Host. t. 16. June, July.
hirtellum, ann. hairy. July and August. Flo. Ger. i. p. 242.
miliaceum, ann. millet; nat. Germ. Host. t. 20.
crus galli, ann. cock's-foot panic; nat. Germ. July and August. Flo. Ger. i. p. 244
crus corvi, ann. crow's-foot panic; nat. East Indies. August; hardy. Willd. i. p. 337.
arborescens, per. tree panic-grass. March and April; tender. Hort. Kew. i. p. 144.
latifolium, per. broad-leaved; nat. North America. August, September. Hort. Kew. i. p. 144.
sanguinale, ann. See *Syntherisma vulgare.*
glabrum, ann. See *Syntherisma glabrum.*
dactylon, per. See *Digitaria stolonifera.*

SECT. VIII. *Grasses with 3 Stamina, 2 Styles, several Flowers in each Calyx—Flowers all bisexual, or the terminating Floret unisexual or barren.*

LOLIUM. Rye-grass, or darnel. Generic character: calyx 1-valve, lateral, fixed, pressing a spiket of flowers close to the rachis, or spike-stalk. Corolla 2 valves, spear-shaped, exterior valve near the apex sometimes awned. Seed covered with the corolla husks, convex on one side, and furrowed on the other.

perenne vulgare, per. rye-grass. Perennial rye-grass, indig. June till August. E. Bot. 315.
var. *tenue*, per. slender rye-grass; the spike is erect, very slender; calyx containing 2 or 3 florets.
var. *compositum*, per. double-spiked rye-grass; spike generally bent, spikets broad, crowded.
var. *ramosum*, per. branched rye-grass; spike with branches towards the top; calyx 8 or 9-flowered.
var. *viviparum*, per. viviparous rye-grass.
temulentum, ann. bearded annual rye-grass, indig. July. E. Bot. 1124.
arvense, ann. field annual rye-grass, indig. June and July. E. Bot. 1125.
var. *majus*, ann. larger field rye-grass. See our specimen.

ÆGILOPS. Goat's-face grass. Generic character: calyx opposite, 2-valved, 3, 4-flowered, ventricose, hard, truncated, furnished with various awns. Corolla 2-valved, exterior valve ovate, terminated by a double or triple awn. Seed oblong, convex on one side, and grooved on the other.

ovata, ann. oval-spiked goat's-face grass; nat. Germ. May. Host. t. 5.
triuncialis, ann. long-spiked; nat. Germ. June. Host. t. 6.
caudata, ann. slender-spiked; nat. Hungary. Linn. Spec. 1489.
squarrosa, ann. rough-spiked; nat. Levant. July. Linn. Spec. 1489.

ROTTBOELLIA. Hard-grass. Generic character: calyx lateral, 1 or 2-valved, 1 or 2-flowered. Corolla 2-valved. Seed oblong, covered by the sinuses of the joints of spike-stalk, which are closed by the calyx, glumes, or husks.

incurvata, ann. sea hard-grass, indig. June. E. Bot. 760.
filiformis, per. slender; nat. South of Europe. July. Willd. 464.
cylindrica, per. four-rowed; nat. South of Europe. August. Willd. 464.
monandra, ann. single hard-grass; nat. Germ. June. Willd. 315. *Nardus aristata.*
Thomæa, ann. St. Thomas's; nat. Tranquebar. Trans. Linn. Soc. *Nardus Thomæa.*
hirsuta, per. hairy; nat. Egypt. August. Willd. 465.

SESLERIA. Moor-grass. Generic character: calyx 2-valved, 2 or 3-flowered, awned. Corolla 2-valved, awned, awns various. Seed covered by the blossom.

elongata, per. long-spiked moor-grass; nat. Germ. June. Host. t. 97.
tenuifolia, per. small-leaved; nat. Germ. June. Flo. Ger. i. p. 272.
cæurlea, per. blue, indig. April and May. E. Bot. 1613. Willd. et alii autor. *Cynosurus cæruleus.*
tenella, per. slender; nat. Germ. June. Host. t. 100.
echinata, ann. rough; nat. Germ. June. Moris. Hist. s. 8, t. 5, fig. 1.

POA. Meadow-grass. Generic character: calyx 2-valved, many-flowered. Corolla, 2-valved. Valves oval, though rather acute. Awnless. Seed covered by the corolla.

aquatica, per. water meadow-grass, indig. July. E. Bot. 1315.
maritima, per. sea meadow-grass. E. Bot. 1140. Indig. July.
distans, ann. reflexed, indig. Summer. E. Bot. 986. Curtis. *Poa retroflexa.*
rigida, ann. hard meadow-grass. May; indig. E. Bot. 1371.
dura, ann. harsh meadow-grass; nat. Germ. June. Host. t. 73.
pilosa, ann. hairy; nat. Germ. June. Host. t. 68.
Eragrostis, ann. spreading; nat. Italy. July. Host. t. 69.

POA. *supina,* per. weak-stemmed meadow-grass; nat. Germ. June. Willd. 386. Var. P. *Alpina.*
laxa, per. loose panicled, indig. Willd. i. p. 386. E. Bot. 1123. *Poa flexuosa.*
flexuosa, per. zig-zag meadow-grass, indig. E. Bot. 1123. Willd. i. 386. *Poa laxa.*
alpina, per. alpine meadow-grass, indig. May. E. Bot. 1003.
bulbosa, per. bulbous meadow-grass, indig. April. E. Bot. 1071.
sudetica, per. broad-leaved; nat. Germ. July. Flo. Ger. i. p. 295.
trivialis, per. rough-stalked meadow-grass, indig. June till September. E. Bot. 1072.
cærulea, per. short blue, indig. May and June. E. Bot. 1004. *P. Subcærulea,* F. B. App. *P. Humilis.*
pratensis, per. smooth-stalked meadow-grass, indig. May and June. E. Bot. 1073.
angustifolia, per. narrow-leaved, indig. May and June. Wither. Arrang. Var. *Poa pratensis.*
fertilis, per. fertile meadow-grass; nat. Germ. June and July. Host. iii. t. 14. Flo. Ger. *Poa serotina.*
serotina, per. Flo. Ger. i. p. 299. See *Poa fertilis.*
nemoralis, per. wood meadow-grass, indig. June and August. E. Bot. 1265.
nemoralis angustifolia, var. narrow-leaved wood meadow-grass. Hudson. Flo. Ang.
compressa, per. flat-stalked, indig. June till August. E. Bot. 365.
compressa stricta, per. var. upright flat-stalked meadow-grass.
annua, ann. annual meadow-grass, Suffolk grass, indig. February till January. E. Bot. 1141.
decumbens, per. decumbent, indig. July. E. Bot. 792. Willd. &c. *Festuca decumbens.*
disticha, per. two rowed; nat. Germ. Host. t. 76. July, August.
cæsia, per. sea-green meadow-grass, indig. July. E. Bot. 1719.
glauca, per. glaucous meadow-grass, indig. June, July. E. Bot. 1720.
cristata, per. See *Aira cristata.*
nervata, per. nerved meadow-grass; nat. North America. July. Willd. 389.
trinevata, per. Willd. See *Festuca calamaria.*
Abyssinica, per. upright meadow-grass; nat. Abyssinia. August. Hort. Kew. i. p. 156.

BRIZA. Quaking-grass. Generic character: calyx 2-valved, many-flowered; flowers collected into heart-shaped spikets. Corolla 2-valved, exterior valve the shape and size of the calyx husks, inferior valve smaller, flat, roundish. Seed compressed.
media, per. common quaking-grass, indig. May and June. E. Bot. 340.
minor, ann. small quaking-grass; nat. Brit. June. E. Bot. 1316.
maxima, ann. great quaking-grass; nat. Italy. August. Willd. Host. ii. t. 30.
virens, ann. green; nat. Spain. August. Linn. Spec. 103.
Monspessulana, Montpelier; nat. France. July. Allion. Pedem. n. 2220.

DACTYLIS. Cock's-foot grass. Generic character: calyx 2-valved, compressed, keeled, acute, one valve shorter than the floret, the other longer. Corolla 2-valved, spear-shaped, awnless. Seed naked, depressed on one side, and convex on the other.
glomerata, per. round-headed cock's-foot, indig. June, and till August. E. Bot. 335.
maritima, per. sea; nat. Germ. July. Flo. Ger. i. p. 313.
cynosuroides, per. American cock's-foot; nat. N. America. Hort. Kew. i. 160. October.
stricta, per. upright, indig. August. E. Bot. 380.
patens, per. spreading cock's-foot; nat. N. America. July and August. Hort. Kew. i. p. 160.

ELYMUS. Lyme-grass. Generic character: calyx lateral, 2-valved, in two's or three's, many-flowered. Corolla 2-valved, spear-shaped, exterior acuminate or awned, interior valve smaller, flat, awnless. Seed, covered, convex on one side, and strap-shaped.
arenarius, per. sea lyme-grass, indig. July. E. Bot. 1672.

ELYMUS *europæus*, per. barley-like lyme-grass, indig. June and July. E. Bot. 1317.
geniculatus, per. jointed lyme-grass, indig. July and August. E. Bot. 1586.
giganteus, per. tall lyme-grass; nat. N. America. August. Hort. Kew. i. p. 176.
Sibericus, per. Siberian; nat. Siberia. July. Hort. Kew. i. p. 176.
Philadelphicus, per. Philadelphian lyme-grass; nat. N. America. July. Hort. Kew. i. p. 176.
Canadensis, per. Canadian lyme-grass; nat. N. America. July and August. Hort. Kew. i. p. 177.
Virginicus, per. Virginian lyme-grass; nat. Virginia. June and July. Hort. Kew. i. p. 177.
striatus, per. striated lyme-grass; nat. N. America. June and July. Hort. Kew. i. p. 177.
caput-medusæ, ann. Portuguese lyme-grass; nat. Portugal. July. Hort. Kew. i. p. 177.
hystrix, per. rough lyme-grass; nat. Levant. July and August. Hort. Kew. i. p. 177.
tener, per. tender lyme-grass; nat. Siberia. July and August. Linn. Spec. 125.

FESTUCA. Fescue-grass. Generic character: calyx 2-valved, many-flowered, containing the florets in a slender spike; valves acuminate, the interior the least. Corolla 2-valved, exterior valve larger than the calyx, acuminate, or awned. Seed acute at both ends, slender and oblong.
ovina, per. sheep's fescue, indig. May and June. E. Bot. 585.
tenuifolia, per. slender-leaved, indig. May and June. Leers. Herborn, t. 8, f. 4.
vivipara, per. viviparous fescue, indig. June. E. Bot. 1355.
rubra, per. creeping rooted, indig. June and July. E. Bot. 2056.
duriuscula, per. hard fescue, indig. June and July. E. Bot. 470.
Cambrica, per. Welsh fescue, indig. Wither. Arr. June.
glabra, per. smooth fescue, indig. Wither. Arr. and Light. June.
dumetorum, per. pubescent, indig. Wither. Arr. June and July.
bromoides, ann. brome-like fescue, indig. June and July. E. Bot. 1411.
myurus, ann. capon's-tail or wall fescue, indig. July. E. Bot. 1412.
uniglumis, ann. single husked, indig. June and July. E. Bot. 1430.
calamaria, per. reed-like fescue, indig. June and July. E. Bot. 1005. Flo. Ger. *Festuca sylvatica.*
pratensis, per. meadow-fescue, indig. July. E. Bot. 1592.
elatior, per. tall fescue, indig. July. E. Bot. 1593.
loliacea, per. darnel-like fescue, indig. June and July. E. Bot. 1821.
calycina, ann. bearded-leaved; nat. Spain. August. Hort. Kew. i. p. 166.
unioloides, ann. uniola-like fescue; nat. N. America. June and July. Hort. Kew. i. p. 166.
gigantea, per. gigantic fescue-grass, indig. July and August. E. Bot. 1820. Curt. Lond. *Bros. giganteus.*
spadicea, per. Gerard's fescue; nat. Germ. June till August. Host. iii. t. 20. *Poa Gerardi. Allion. Ped.*
sylvatica, per. See *Festuca calamaria.*
flavescens, per. yellow fescue; nat. Hungary. May.
pinnata, per. See *Bromus pinnatus.*
gracilis, per. See *Bromus sylvaticus.*
distachyos, ann. See *Bromus distachyos.*

BROMUS. Brome-grass. Generic character: calyx 2-valved, many-flowered, valves ovate-oblong. Corolla 2-valved, valves spear-shaped; exterior valve concave, obtuse, bifid, putting out a straight awn below the top or apex. Seed oblong, covered.
mollis, ann. soft annual brome-grass, indig. May and June. E. Bot. 1078.
multiflorus, ann. many-flowered brome-grass, indig. June and July. E. Bot. 1884.
secalinus, ann. smooth rye brome-grass, indig. June and July. E. Bot. 1171.
arvensis, ann. field brome-grass, indig. July. E. Bot. 1984.
lanceolatus, ann. spear brome-grass; nat. coast of the Caspian Sea. Hort. Kew. i. p. 167.

BROMUS.

squarrosus, ann. corn brome-grass, indig. July. E. Bot. 1885.
purgans, ann. purging brome-grass; nat. Canada. July. Hort. i. p. 167.
inermis, per. smooth awnless brome-grass; nat. Germ. July. Host. i. t. 9.
asper, ann. hairy wood brome-grass, indig. July and August. Curt. Lond. *Bro. hirsutus.*
sterilis, ann. barren brome-grass, indig. June and July. E. Bot. 1030.
erectus, per. upright brome-grass, indig. June. E. Bot. 471.
tectorum, ann. nodding brome-grass; nat. Germ. June. Host. i. t. 15.
rubens, ann. Spanish brome-grass; nat. Spain. June. Host. i. t. 18.
racemosus, ann. branching brome-grass, indig. June. E. Bot. 1079.
diandrus, ann. upright annual brome-grass, indig. July. E. Bot. 1006. Host. *B. madritensis.*
sylvaticus, per. wood brome-grass, indig. August. E. Bot. 729. Willd. & Mart. *Festuca sylvatica.*
pinnatus, per. spiked brome-grass, indig. July. E. Bot. 730. Flo. Ger. *Festuca pinnata.*
distachyos, ann. two-rowed brome-grass; nat. Germ. Host. i. t. 20. Flo. Ger. *Festuca distachyos.*
giganteus, per. tall or gigantic brome-grass. See *Festuca gigantea.*

AVENA. Oat-grass. Generic character: calyx 2-valved, many-flowered, florets loosely collected. Corolla 2-valved, valves spear-shaped; exterior valve awned; awn, from the back of the valve, twisted and jointed. Seed, covered firmly by the corolla husk.

strigosa, ann. meagre oat-grass, indig. June. E. Bot. 1266.
brevis, ann. short; nat. Germ. June. Host. iii. t. 42.
sterilis, ann. barren oat; nat. Germ. May and June. Host. ii. t. 57.
Orientalis, ann. Turkey oat; nat. Germ. July. Host. iii. t. 44.
nuda, ann. naked, or pilcorn, indig. July. Wither. Arr. ii. 164. Cultivated in Cornwall. Ray.
fatua, ann. bearded oat, or haver, indig. August.
tenuis, ann. slender oat; nat. Germ. June. Host. ii. t. 55.
sativa nigra, ann. cultivated black oat. July and August. Flo. Rust. t. 79.
sativa alba, ann. cultivated white oat. July. Bauh. Pinx. 23.
Pennsylvanica, ann. Pennsylvanian oat; nat. North America. Linn. Spec. 117.
Siberica, ann. Siberian oat; nat. Siberia. Lin. Spec. 117.
loeflingiana, ann. Spanish oat; nat. Spain. July. Linn. Spec. 118.
fragilis, ann. brittle; nat. Germ. and Spain. June. Host. v. ii. t. 54.
sempervirens, per. evergreen oat; nat. Germ. June. Host. v. iii. t. 41.
flavescens, per. yellow oat, golden oat, indig. June and July. E. Bot. 952.
pratensis, per. meadow oat, indig. June and July. E. Bot. 1204.
pubescens, per. downy oat, indig. June and July. E. Bot. 1640.
alpestris, per. rock oat; nat. Germ. August. Host. v. iii. t. 39.
brevifolia, per. short-leaved; nat. Germ. Host. v. iii. t. 40.
distichophylla, per. fan-leaved; nat. Germ. May and June. Host. v. ii. t. 53.
planiculmis, per. broad-stalked, indig. July and August. E. Bot. 2141.
versicolor, per. various-coloured oat; nat. Germ. August. Host. v. ii. t. 52. *A. Scheuchzeri.*
elatior, per. tall oat. See *Holcus avenaceus.*

CYNOSURUS. Dog's-tail grass. Generic character: calyx 2-valved, 2 to 5-flowered. Corolla 2-valved; valves linear spear-shaped, exterior awnless, or with an awn terminating the apex. Seed covered by the corolla; the spikets in most species with leafets on one side, *(involucre)*, or husks on a leaf-stalk, *(stipatæ)*.

cristatus, per. crested dog's-tail grass, indig. June and July. E. Bot. t. 316.

CYNOSURUS. *echinatus,* ann. rough-spiked, indig. June. E. Bot. t. 1333.
Lima, ann. imbricated; nat. Spain. July. Linn. Spec. 105.
coracanus, ann. thick-spiked; nat. East Indies. August. Linn. Spec. 106.
aureus, ann. golden dog's-tail grass; nat. Germ. Host. v. iii. t. 4.
erucæformis, per. linear-spiked; nat. Germ., and Hudson's Bay, and Russia. Host. v. iii. t. 6. *Beckmania erucæformis.*
Egypticus, ann. creeping; nat. Africa and Asia. August. Hort. Kew. v. i. p. 163.
durus, ann. See *Poa dura.*

TRITICUM. Wheat-grass. Generic character: calyx, a common receptacle elongated into a spike, husks 2 valves, many-flowered. Corolla 2-valved, spear-shaped; exterior valve ventricose, obtuse, with a point or an awn; the interior valve flat. Seed ovate, oblong, at both ends obtuse, convex on one side, and furrowed on the other.

caninum, per. bearded perennial wheat-grass, indig. July. E. Bot. t. 1372. Willd. *Elymus caninus.*
repens, per. creeping-rooted or couch-grass, indig. July and August. E. Bot. 909.
elongatum, per. long-spiked; nat. Germ. July. Host. v. ii. t. 18.
junceum, per. rush-leaved, indig. July. E. Bot. 814.
loliaceum, ann. darnel-like wheat-grass, indig. June and July. E. Bot. t. 221.
tenellum, ann. dwarf wheat-grass; nat. Spain. July. Host. v. ii. t. 26.
æstivum, ann. spring wheat; nat. unknown. Willd. 476.
hybernum, ann. Lammas wheat; nat. unknown. Moris. Hist. s. 8, t. 11, f. 1.
1. var. *muticum,* ann. red Lammas wheat; nat. unknown. Park. Theat. 1120, f. 1.
2. *spica et granis rubentibus,* red, or Kentish wheat. Raii. Hist. 1237, Synon. 386.
3. *spica et granis albis,* white wheat. Raii. Hist. 1237, Synon. 386.
4 *aristis munitum,* red-eared bearded wheat. Moris. Hist. s. 8, t. 1.
5. *album,* white-eared bearded wheat. Moris. Hist. iii. 175.
compositum, ann. many-spiked wheat. Moris. Hist. s. 8, t. 1, f. 7.
turgidum, ann. Barbary wheat. Ibid. s. 8, t. 1, f. 14.
var. 1. *quadratum,* ann. cone wheat. Ibid. f. 13.
Polonicum, ann. Polish wheat. Ibid. s. 8, t. 1, f. 8.
Spelta, ann. Spelt wheat. Ibid. s. 8, t. 6, f. 1.
var. *zea amylacea,* Ibid. s. 8, t. 6, f. 3.
monococcum, ann. one-grained wheat. Moris. Hist. s. 8, t. 6, f. 2. *Zea briza.*
Exception. *Festuca myuurus.* Stamina 1.

This Catalogue contains upwards of three hundred and twenty distinct species and varieties of grass, of which, one hundred and fifty are indigenous to Great Britain; but, as the discoveries of Botanists still continue to add to the number new species and varieties, the term *complete* cannot be applied to this enumeration.

As every different soil produces grasses peculiar to itself, and as no other kinds can be established or cultivated upon it, without first changing its nature to resemble that which produced the kinds of grasses we wish to introduce; it becomes a point of the first importance, in making experiments on different species of this numerous family of plants, and in stating the results, to determine with sufficient accuracy, the nature of the soil, or different soils employed, and to describe them accordingly.

In many instances, where experiments have been made on the produce of plants, this very essential point has been too much disregarded. It is to this only we can look for a satisfactory reason to reconcile the discordance of results obtained from experiments made on the same plant by different persons equally eminent for agricultural knowledge. From the same source, in a great measure, will be found to proceed the difference of opinion respecting the impoverishing effects of different plants to the soil. It is well known that, on certain soils, some plants have greater impoverishing effects than on others; and though the preparation of the land, and quantity of manure applied, &c. should be the same in two cases, yet a specific difference in the nature of the soils, will give different results as to their produce and impoverishing effects.

The terms adopted to denote different soils, have been used without due precision, or rather, the terms have had no definite idea affixed to them. The term *loam*, for instance, is defined by one to be a fat earth, or marl, and by others, a mixture of clay, sand, and calcareous earth, without stating the proportions. In general, on referring to books on Agriculture and Gardening, we are directed to a hazel loam, a brown loam, clayey loam, or to a hungry sandy soil, bog soil, peat earth, garden mould, &c.; but from the want of proper definitions of these terms, it is perplexing, or nearly impracticable, to determine which kind of soil is meant. I have examined above fifty kinds of soil and composts collected, with their local names, in different parts of the country, and, in several instances, soils of the same name were found to differ greatly in their natural qualities.

The method of determining the nature of soils by chemical analysis, has been of late years so much simplified by Sir Humphry Davy, that it is now in the power of every practical person to ascertain with comparative facility, the qualities of any kind of soil, and consequently to describe the same without any risk of being misunderstood, which before this, was absolutely unavoidable.

All soils consist of sand of various degrees of fineness, and impalpable earthy matter; when, therefore, the exact proportions in which these are combined in a soil, are known, with their general properties, it shews directly to which class of soils it belongs, whether to the loamy, clayey, calcareous, sandy, peaty, &c.

Sir Humphry Davy, in his Elements of Agricultural Chemistry, states the proportions of sand, and impalpable earthy matter, to which the terms usually adopted should be limited. "The term sandy, should never be applied to any soil that does not at least contain seven-eighths of sand; sandy soils, that effervesce with acids, should be distinguished by the name of calcareous sandy soil, to distinguish them from those that are siliceous. The term clayey, should not be applied to any land that contains less than one-sixth of impalpable earthy matter, not considerably effervescing with acids; the word loam, should be limited to soils containing at least one-third of impalpable earthy matter. A soil to be considered as peaty, ought to contain at least one-half of vegetable matter."—These may be considered as the generic characters of soils, and determined by a very simple process, that of washing the impalpable earthy matter of the soil from the sandy portion, and by drying and ascertaining their respective weights, when the application of an acid, shews whether it belongs to the calcareous or siliceous kinds of soil.

The results of all my observations, in these experiments on grasses, and likewise in the cul-

tivation of a large collection of plants on various kinds of soil, tend to confirm the opinion, that the fitness or unfitness of particular soils for particular plants, depends, in a general sense, on the due proportions of sand, and impalpable earthy matter, of which they consist. If writers, therefore, on the comparative produce of plants, whether of the farm or the garden, would only thus far describe the nature of the soils employed in their experiments, the benefit of it would be felt, and duly appreciated, by every practical person; but more so, by those who wish to repeat such experiments. But misconception with respect to the nature of soils employed in experiments, must be effectually prevented, by ascertaining the number and proportion of the constituent parts, because the smallest difference in the natural qualities of soils is thereby detected. It would surely assist in raising the art of Agriculture to the certainty of science, if, in all experiments on the comparative produce of plants, the intimate nature of the soil, as well as the properties of the subsoil, were accurately determined.

The following details are intended to shew the nature of those soils which have been employed in this series of experiments on grasses.

I. *Poor Siliceous Sandy Soil.*

400 grains deprived of its moisture, consisted of,

Fine sand, chiefly siliceous	337 grains.
Carbonate of lime, or chalk	2
Decomposing vegetable matter destructable by fire	4
Silica, or the earth of flints	32
Alumina, or the pure matter of clay	10
Oxide of iron	5
Soluble matter, principally saline	2
Loss	8
	400

II. *Siliceous Sandy Soil, or Hungry Sand.*

400 grains, deprived of moisture, gave of

Fine siliceous sand	355 grains.
Carbonate of lime, or chalk	4
Decomposing vegetable matter destructable by fire	6
Silica, or the matter of pure clay	11
Alumina, or pure clay	6
Oxide of iron	3
Soluble vegetable and saline matters	3
Loss	12
	400

Obs. This soil, which was comparatively barren without the frequent application of large portions of manure, and which had only a transient effect, was permanently fertilized by the application of tenacious clay, (No. IX.)

III. *Heath Soil, or Black Siliceous Moor Soil.*

400 grains, deprived of moisture, gave of

Fine sand, principally siliceous	315 grains.
Decomposing vegetable matter	65
Silica, or the earth of flints	9
Alumina, or the pure matter of clay	2
Oxide of iron	2
Soluble matter, principally vegetable extract and common salt	6
Loss	1
	400

IV. *Rich Siliceous Soil, or Rich Sandy Soil.*

400 grains, deprived of moisture, afforded of

Fine sand, chiefly siliceous and partly calcareous	298 grains.
Coarse gravel	9
Carbonate of lime, or chalk	3
Carbonate of magnesia	1
Decomposing vegetable matter destructable by fire	30
Silica, or the earth of flints	31
Alumina, or the matter of pure clay	8
Oxide of iron	4
Soluble matter, consisting of vegetable extract and phosphate of lime	4
Loss	12
	400

Obs. This soil, when on a clayey subsoil, produced large crops for two successive seasons, but afterwards required a regular supply of manure. When the subsoil was porous, or consisted of gravel, the produce was very inferior. It is properly a *hungry* soil, and requires an addition of clay, and calcareous earth, to render it permanently fertile.

V. *Sandy Loam, or Brompton Common Loam.*

400 grains, deprived of moisture, consisted of

Fine sand, partly siliceous and partly calcareous	280 grains.
Carbonate of lime	4
Carbonate of magnesia	1
Decomposing vegetable matter	19
Silica, or earth of flints	53
Alumina, or matter of pure clay	15
Oxide of iron	4
Soluble matter, principally vegetable extract and sulphate of potash	4
Loss	20
	400

Obs. This soil affords an illustration of the term loam, in its general acceptation among Husbandmen and Gardeners in the neighbourhood of London.

VI. *Rich Black Clayey Loam.*

400 grains of the entire soil consisted of

Water of absorption	65 grains.
Fine sand	165
Carbonate of lime	20
Vegetable matter	39
Silica	61
Alumina	20
Oxide of iron	5
Soluble matter, saline and vegetable	4
Loss	21
	400

VII. *Clayey Loam.*

400 grains, freed from moisture, gave of

Fine sand, partly calcareous and partly siliceous	190 grains.
Carbonate of lime	8
Vegetable matter	18
Silica	110
Alumina	58
Oxide of iron	7
Soluble vegetable and saline matters, principally sulphate of magnesia	5
Loss	5
	400

VIII. *Tenacious Clay.*

400 grains, deprived of moisture, consisted of

Fine sand	159 grains.
Vegetable matter	10
Carbonate of lime	25
Carbonate of magnesia	2
Silica	111
Alumina	55
Oxide of iron	8
Soluble saline matter, chiefly sulphate of lime, and a little sulphate of magnesia	11
Loss	19
	400

IX. *Rich Alluvial Soil, partly formed by the Deposition of flowing Water.*

400 grains deprived of moisture, gave of

Fine sand	115 grains.
Aluminous stones	70
Carbonate of lime	23
Decomposing vegetable and animal matter	34
Silica	100
Alumina	28
Oxide of iron	13
Sulphate of lime or gypsum	2
Carbonate of lime	
Soluble vegetable and saline matters	7
Loss	8
	400

Obs. Of all the soils employed in the experiments, this one was the most productive: it was upon a porous subsoil; all the superior grasses flourished here in an extraordinary degree: it therefore offers data whereby to judge of the comparative value of soils for grasses.

X. *Vegetable Mould.*

400 grains, freed from moisture, gave of

Fine sand	231 grains.
Undecompounded vegetable fibre	13
Decomposing vegetable fibre	57
Silica	50
Alumina	18
Soluble matter, principally vegetable extract	4
Oxide of iron	2
Loss	25
	400

XI. *Active Peat, or Fertile Peat Moss.*

400 grains, freed from moisture, gave of

Fine siliceous sand	156 grains.
Undecompounded vegetable fibre	2
Decomposing vegetable matter	110
Muriate of lime	4
Silica	102
Alumina	16
Oxide of iron	4
Soluble vegetable and saline matter	4
Loss	2
	400

XII. *Inert Peat, or Barren Peat Moss.*

400 grains, freed from moisture, consisted of

Fine pure siliceous sand	29 grains.
Inert vegetable matter	289
Alumina	14
Oxide of iron	30
Soluble vegetable matter, containing also sulphate of potash	11
And sulphate of lime, or gypsum	12
Loss	15
	400

In one instance, beds of these soils (No. II. and No. VIII. excepted) were arranged in the order in which they have just now been mentioned. Seeds of all the grasses peculiar to each soil, were sown on distinct spaces of each bed. The seeds of the different grasses vegetated on all the soils, except on the inert peat (No. XII.), which remained completely barren. In the ensuing season, it was remarkable to see the different degrees of luxuriance exhibited by the same species of grass on different soils. The superior grasses, or those which constitute the produce of rich ancient pasture lands, formed nearly a perfect convex ridge of grass: beginning at the poor siliceous sandy soil (No. I.), where they were the most diminutive, they gradually increased in luxuriance, till they reached the bed of rich alluvial soil (No. IX.), and afterwards decreased in the quantity of produce, till they terminated at the inert peat (No. XII.) It is of importance to observe, however, that after the second year, this order of luxuriance did not continue in the same proportion. The rich siliceous sandy soil, on the fourth and fifth year, was greatly inferior in produce to what it was on the second and third, and the produce of the poor siliceous sandy soil decreased annually in quantity after the second year. The produce of the sandy loam, and clayey loam, continued much the same; but the rich alluvial soil, and rich clayey loam, increased in the quantity of produce till the fifth year, and have since continued, with but a trifling diminution in the weight of their annual crops, though no manure in any instance has been applied.

By referring to the details which shew the composition of the rich siliceous sandy soil, which soonest became deficient of produce, it appears, that the finely divided matter contains more of decomposing vegetable matter, in proportion to the earthy ingredients, than that of the rich alluvial soil, and of the clayey loams. The proportion of sand to the finely divided matter, is likewise much greater in that soil, than in the others, whose productive powers seemed rather to increase for five successive years.

A space of the poor siliceous soil was richly manured, and the produce of grass for two years exceeded that of the rich siliceous soil which had no manure; but on the fifth year was so much reduced, as hardly to equal its original produce. These facts confirm the opinion, that certain soils may produce large crops of grain, or other annual crops, but are nevertheless unfit for the production of the superior perennial grasses.

It may be said, that as the want of a due proportion of finely divided earthy ingredient is all that is needed, to render these soils equal to the best, the clay, chalk, &c. may be applied

in sufficient quantity to effect so desirable an end. In the instance of the rich siliceous soil, and all others of a similar nature, this may be effected under ordinary circumstances with little trouble, and at a moderate expence. But we shall find, on referring to the details which shew the composition of the poor siliceous sandy soil (No. I.), for instance, that the expence of applying so large a quantity of ingredients as that soil requires, would exceed the value of the improvement under ordinary circumstances. A chemical examination of these soils, affords the clearest evidence to determine what degree of improvement they are susceptible of receiving, to be of the most advantage, whether for the production of the superior perennial grasses, or for annual crops only.

The composition of the tenacious clay (No. VIII.), shews that it contains all the ingredients necessary for the improvement of the poor siliceous soil (No. I.), except that of decomposing vegetable and animal matter, which is to be supplied by manure.

A cubic inch of that clay, when newly dug, weighs 700.8 grains; when freed from moisture, 584 grains. Suppose one cubic inch of clay to be applied to 29 cubic inches of the soil, it would reduce the proportion of sand, and increase the proportion of finely divided earthy matter, of its former composition, in the following degree:

1 cubic inch of poor siliceous sandy soil, as before stated, consists of,

Fine sand - - - -	434.875 grains.
Decomposing vegetable matter -	7.35
Carbonate of lime or chalk - -	4.9
Silica, or the earth of flints - -	13.475
Alumina, or the matter of clay -	7.35
Oxide of iron - - - -	3.675
Soluble vegetable, and saline matters -	3.675
Carbonate of magnesia	

1 cubic inch of the tenacious clay, added to 29 of the soil, alters the proportions in one cubic inch, to,

Fine sand - - -	428.1171 grains.
Decomposing vegetable matter, -	7.5916
Carbonate of lime or chalk - -	5.956
Silica - - - -	18.4278
Alumina - - -	9.7816
Oxide of iron - - -	39.418
Soluble saline matter - -	4.0876
Carbonate of magnesia - -	0.0973

The quantity of clay necessary to effect the above alteration in an acre of the siliceous soil to the depth of six inches, and the probable expence attending it, appear to be as follows:

One acre of land, six inches deep, contains 376.35840 cubic inches. A cart-load, or one ton of clay, contains 21479.43744 cubic inches, which, applied in the proportion of one part to 19, as above, shews that 60 cart-load, or 745.81380 cubic feet of clay, is requisite to effect that change in its nature.

In ordinary cases, the expence of digging, filling, and spreading the clay, is three-pence three farthings per cart-load, consequently the expence per acre, would be eighteen shillings and nine-pence, exclusive of cartage. Now if the soil thus improved, be compared with any of the preceding soils that are mentioned as fitted for the growth of the superior perennial grasses, it will appear to be still very far from their natural composition, and proportionally less adapted to the growth of these grasses. Even to bring it near to the nature of the sandy loam, (No. VI.), it would require 800 load per acre. Therefore, though this soil is unfit for the growth of the superior grasses, it is capable of great improvement for the production of grain or bulbous crops, by the application of clay and calcarious matter; it will thereby require less manure, and better sustain the effects of a continuance of dry weather.

The rich siliceous soil may have its nature changed, to resemble that of the sandy loam, by the application of two parts of clay to twenty-nine of soil, or 120 load to the acre.

The above facts* and observations may likewise shew in some measure, one out of many of the very useful practical purposes, to which the results of a chemical examination of soils may be made subservient.

The subsoil is of as much importance, in determining the fitness, or unfitness, of a soil for the growth of the superior grasses, as the nature of the surface soil; and, indeed, when it is considered that the latter may have its nature completely changed, under favourable circumstances, with little trouble and at a moderate expence, while the nature of the subsoil can only be partially corrected under any circumstances, it may therefore be said to be of the first importance in this enquiry.

In the following details of experiments, the nature of the subsoil is therefore mentioned, and more particularly in instances where one soil has been cultivated on different subsoils.

The most productive old pasture lands consist of soils of an intermediate quality as to moisture and dryness, varying in the degree of fertility according to the manner of management, or the frequency of hay crops, and the exclusion of top-dressing with manure; but the grasses which constitute their produce are the same. Dry elevated sandy soils, however long they may have been under pasture and superior management, produce a different class of grasses of inferior merits. The produce of peat bogs, and low wet soils likewise, for the most part, consist of grasses which differ from those above-mentioned, in regard to value as well as botanical distinctions. The respective merits and comparative value, therefore, of the different grasses natural to these particular situations, will probably be more readily and conveniently seen, if every species be considered under its own particular soil, and compared with those that are naturally combined with it. With this end in view, the details of the experiments are arranged under four heads, viz. 1st, Grasses, and other plants, adapted for permanent pasture on soils of the first quality; 2d, Grasses, and other plants, natural to dry sandy soils; 3d, Grasses, and other plants, natural to irrigated meadows and low damp soils; 4th Grasses, with such other plants as now appear, from the results of experiments made upon them, to be adapted to the alternate husbandry.

* The Author has the pleasure to inform those Gentlemen who may desire to examine the soils that have here been submitted to analysis, that neat cabinet specimens of the whole may be had of Mr. Sowerby, at his Museum of Natural History, Mead-place, Lambeth.

HORTUS GRAMINEUS WOBURNENSIS.

Of the Grasses, and other Plants, which constitute the Produce of the richest Natural Pastures.

IT has long been a prevailing opinion, that rich pasture land, when once broken up for a course of crops, cannot for a great length of time be again brought to so good a sward; and this opinion is founded on the best grounds—on experience. The causes why those grasses, which constitute this valuable sward, cannot be renewed in as great perfection after a few years' removal from their natural soil, must either be, that these plants require many years to attain to that degree of productiveness, or, that the soil has been too much deteriorated by the crop, or course of grain crops, taken previous to renewing the grasses; or, lastly, that the seeds of grasses different from those which composed the valuable sward, have been employed in their stead. Whether to one, or all of these points, the want of success is to be imputed, it is of importance to enquire.

Grasses, like all other vegetables, possess a peculiar life, in which various periods may be distinctly marked. Some species of grass are annual, or arrive at perfection in one year, and then die away; as different species of brome-grass, fox-tail grass, rye-grass, oat-grass, &c. Other species, in two or three years attain to that degree of perfection which they never exceed; as perennial rye-grass, (*Lolium perenne*); rough meadow-grass, (*Poa trivialis*); meadow cat's-tail grass, (*Phleum pratense*); tall oat-like soft-grass, (*Holcus avenaceus*); round cock's-foot grass, (*Dactylis glomerata*), &c.; and there are but few grasses that require five or six years to bring them to that state of productiveness which they never exceed, if properly treated during that time: meadow fescue, (*Festuca pratensis*); meadow foxtail, (*Alopecurus pratensis*); meadow barley, (*Hordeum pratense*); smooth meadow-grass, (*Poa pratensis*); and meadow oat-grass, (*Avena pratensis*), are of this number. These facts, obtained from the results of experiments, and attentive observation, made on these grasses, when cultivated singly, and also when combined with others, as in their natural places of growth, offer sufficient proofs to decide that it is not the great length of time they require to arrive at perfection, that the want of success, in attempts to renew rich pastures, is to be imputed.

On converting this land into tillage, the first crops are, generally, too luxuriant. Were we to conclude, from this circumstance, that the superior pasture grasses require a much richer soil to produce them in perfection, than what is required for the production of grain crops, and, consequently, that a course of white crops, by lessening considerably this degree of fertility, would proportionally render the land less fitted for the re-production of its former valuable grasses, it would not be just; because it is evident this over-richness of the land for the

first crops of grain, does not arise solely from *that degree of richness* in the soil which produced the superior grasses in *such abundance,* but rather from the accession of so large a quantity of vegetable matter, which is at once supplied to the land by ploughing in the turf.

Having met with no specific information in any agricultural works within my reach, respecting the change produced on the nature of rich pasture land by a course of grain crops, I made several experiments to supply the apparent defect. The results of one of these experiments I may be permitted to detail.

A space of two square yards of rich ancient pasture land, was dug to the depth of the surface-soil, which was eight inches, and removed to a place more convenient for making the experiment, but placed on a subsoil of the same nature as that on which it was before incumbent. Three inches from the bottom of the mass were first placed on the subsoil, and the turf was then reversed on this, to the depth of five inches: this mode was adopted, to place the ground under circumstances as similar as possible to that of ploughing it five inches deep, in the usual manner of breaking up pasture land.

The nature of the soil was now ascertained, by taking up a portion of it to the full depth, only rejecting the green living vegetable parts of the turf.

400 grains, freed from moisture and the plants of grass, consisted of

Calcareous and siliceous sand, of different degrees of fineness - -	102 grains.
Decomposing vegetable matter, and particles of roots - - - -	55
Carbonate of lime, or chalk - - - - - -	160
Silica, or earth of flint - - - - - - -	50
Alumina, or pure matter of clay - - - - -	25
Oxide of iron - - - - - - - - - s -	4
Soluble vegetable matter, and sulphate of lime, or gypsum - -	4

The soil was then cropped for five seasons alternately, with, 1st, Oats; 2d, Potatoes; 3d, Wheat; 4th, Carrots; and 5th, Wheat—to the end that it might suffer as much as could possibly happen, under ordinary circumstances, by an impoverishing, or injudicious rotation of annual crops. Every trace of the turf was by this time entirely lost in the general mass of the soil, which was now examined, to ascertain what change it had undergone by these crops. It appeared to consist of

Calcareous and siliceous sand, nearly as before - - - - -	100 grains.
Decomposing vegetable matter, destructable by fire - - - -	48
Carbonate of lime, or chalk, nearly as before - - - -	159
Silica, or earth of flint - - - - - - -	57
Alumina, or pure matter of clay - - - - - - -	26
Oxide of iron - - - - - - - -	5
Soluble vegetable and saline matter - - - - -	3

The above details shew that very little, if any change, had taken place in the constitution of the soil, in respect of its earthy ingredients; but a very considerable diminution of its decomposing vegetable and animal matters; particularly when it is considered how great an addition had been made to the original proportion it contained of this constituent, by the turf, which was incorporated with the soil.

The finely divided animal and vegetable matters of soils are so intimately blended with the other constituents, that manure, though applied in sufficient quantity to supply its loss, requires considerable time to bring its parts into that minute state of division, in which it was found in the rich pasture land on the first examination before mentioned. It is evident the finely divided vegetable matter of the pasture land had been supplied to it (as it is indeed to all other pasture lands), by manure successively applied to the surface, either by the cattle which grazed upon it, or by top-dressing, and divided and carried into the soil by the effects of rain. That this essential ingredient of the fertility of soils is exhausted, even by the growth of the pasture grasses, when the annual supply of manure is suspended, is shewn by daily experience; as in the instance of mowing a pasture for several seasons successively without any top-dressing, or depasturing with cattle: the produce of grass is found to decrease annually, and if the practice is continued long, it will require nearly as many years, under the best management, to bring the pasture to as productive a state as it was previous to the suspension of its annual supply of surface manure. This likewise shews, that pasture land arrives at a certain degree of productiveness which it never exceeds, but at the expence of the *quality* of its produce; as the surface becomes unequal, the grass *rank*, of a coarse nature, and less grateful to cattle. In this case (which does sometimes happen), the grass may be brought back to its grateful and nutritive state, by stocking the pasture sufficiently with different cattle in succession throughout the season; the insufficiency of which seems to be the principal cause of the evil. But when such plants as knapweed *(Centaurea nigra)*, different species of *senecio, hieracium, sonchus, carduus,* &c. that are of no value as food for cattle, have established themselves in these pastures, from the neglect of foul hedges and road-sides, which abundantly supply the seeds of these plants, or part of them, according to the nature of the soils; the remedy of hard-stocking, and even weeding, will be found inadequate to extirpate these unprofitable plants. But to return to the details of the experiment.

The results of the last chemical examination of the soil, had shewn that it had lost a very considerable portion of its decomposing vegetable and animal matters. To supply this deficiency in some measure, manure was now, for the first time, applied, and, with the wheat stubble, dug in to the depth of six inches*; the surface was then made fine with a rake, and sown with a mixture of the following grass-seeds, at the rate of five bushels to the acre.

Festuca pratensis, (meadow fescue); *Alopecurus pratensis,* (meadow foxtail); *Dactylis glomerata,* (round cock's-foot); *Holcus avenaceus* (tall oat-like soft-grass); *Vicia sepium* (creeping vetch); *Lolium perenne,* (rye-grass); *Phleum pratense,* (meadow cat's-tail); *Cynosurus cristatus,* (crested dog's-tail); *Avena flavescens,* (yellow oat); *Avena pratensis,* (meadow oat); *Festuca duriuscula,* (hard fescue); *Poa trivialis,* (smooth-stalked meadow-grass); *Poa fertilis,* (fertile meadow-grass); *Poa nervata,* (nerved meadow-grass); *Trifolium medium,* (cow clover); *Trifolium repens,* (Dutch, or white clover); *Agrostis stolonifera,* (stoloniferous bent, or fiorin); and *Agrostis palustris,* (marsh bent).

The seeds of the six first mentioned grasses being much larger than the others, were first

* The dung was buried to this depth, in order to supply the leading roots of the perennial grasses in the ensuing seasons; a circumstance not wanted in the same degree for *annual* grain crops, whose roots do not penetrate so deep into the soil, and which greedily exhausts manure, however gross.

mixed and sown, and covered with the rake; the rest of the seeds were mixed and sown, without any other means of covering but that afforded by the roller, which was liberally employed till the surface was perfectly level and consolidated. This was effected on the 23d of August, 1813.

The seeds of all these grasses vegetated before the first week of October, except the seed of the *Vecia sepium*, which did not vegetate till the autumn of the succeeding year. Before the frost set in, these seedling grasses had a top-dressing, with compost of rotten dung, lime, and vegetable mould, laid on in a fine and dry state, after which the ground was again well rolled: in the month of February this operation was repeated, when the ground was sufficiently dry to admit of it. The plants sprung earlier than those of the old pasture (a circumstance common to young plants in general). In April, the weeds which had accompanied the top-dressing were carefully cleared away; and the rolling was repeated, to keep the surface compact. The plants grew vigorously, till a continuance of unfavourable weather, in the end of June, checked their growth. On the first week of July, the produce was cut and weighed; it amounted to one-eighth more than the produce of the ground in its original state, but which had been fed off with sheep in the spring; the after-math of the seedling grasses, however, weighed one-fifth less than that of the natural pasture. A very slight top-dressing was applied in the month of November, and the whole was then well rolled; this operation was continued at favourable opportunities till April last (1815). The grass was cut and weighed in the first weeks of June and August, and again in the middle of September; the total weight of these three crops exceeded that of the old turf, exactly in the proportion of eight to nine.

It is therefore evident, that the results of the two modes of experiment here adopted, perfectly agree in confirming the opinion, that a five years course of the more impoverishing annual crops, may be taken from land of the *nature* before described, without unfitting it for the reproduction of the superior natural grasses.

The first, or that of ascertaining the nature of the soil before and after undergoing the impoverishing course of crops, proves, that the loss of decomposing animal and vegetable matter, is the principal injury it sustained, which it is evident may be supplied by manure, though not in one season. The actual experiment of sowing the grasses on the soil thus cropped, and comparing the produce with that which it yielded in its natural state, proves clearly, that after undergoing a course of crops, it may be returned to grass, and afford a produce more abundant than before*.

The different grasses, and other plants, which compose the produce of the richest natural pastures, are in number twenty-five. From the spring till the end of autumn, there is not a month but what constitutes the particular season of luxuriance of one or more of these grasses: hence proceeds the constant supply of rich succulent herbage throughout the whole of the season; a circumstance which but seldom or never happens in artificial pastures, where the herbage consists of two or three plants only. If the best natural pastures be examined with care

* The produce of the different annual crops, grain, and bulbs, were all heavy, except that of the last crop of wheat, which was very inferior, as might be expected. The exact weight of each crop was not ascertained, as the experiment was not made with any view to obtain a knowledge of the comparative advantages or disadvantages of permanent pasture and tillage land; but merely for the purpose above-mentioned. How much less a judicious rotation of crops might have affected the soil, cannot at this moment be decided; but it will be allowed, that a more severe course of crops could hardly have been adopted.

during various periods of the season, the produce will be found to consist of the following plants.

Alopecurus pratensis, (meadow foxtail), *Dactylis glomerata*, (round cock's-foot), *Festuca pratensis*, (meadow fescue), *Phleum pratense*, (meadow cat's-tail), *Anthoxanthum odoratum*, (sweet-scented vernal-grass), *Holcus avenaceus*, (tall oat-like soft-grass), *Vicia sepium*, (creeping vetch), *Lolium perenne*, (rye-grass), *Bromus arvensis*, (field brome-grass), frequent, *Poa annua*, (annual meadow, or Suffolk-grass), *Avena pratensis*, (meadow oat-grass),	Which afford the principal grass in the spring, and also a great part of the summer produce.
Avena flavescens, (yellow oat-grass), *Hordeum pratense*, (meadow barley), *Cynosurus cristatus*, (crested dog's-tail), *Festuca duriuscula*, (hard fescue), *Poa trivialis*, (rough-stalked meadow-grass), *Poa pratensis*, (smooth-stalked meadow-grass), *Holcus lanatus*, (woolly soft-grass), sparingly, *Trifolium medium*, (cow-clover, or perennial red clover), *Trifolium repens*, (white, or Dutch clover), *Lathyrus pratensis*, (yellow vetch, or meadow lathyrus), *Festuca glabra*, (smooth fescue),	Which yield produce principally in summer and autumn.
Agrostis stolonifera, (creeping bent, or fiorin), *Agrostis palustris*, (marsh bent-grass), *Triticum repens*, (creeping wheat-grass, or couch),	Which vegetate with most vigour in autumn.

Besides these, there are other plants that I have invariably found in the richest natural pastures, as *Ranunculus acris*, (butter-cups); *Achillea millefolium*, (milfoil, or yarrow); *Plantago lanceolata*, (rib-grass, or ribwort plantain), and *Rumex acetosa*, (sorrel-dock). But of these, the rib-grass and butter-cups were by far the most common, the yarrow and sorrel-dock being confined to particular spots. I have been in the practice for many years, of examining these pastures at various periods of the season, but I never could discover the smallest indication of the cattle (horses, cows, and sheep) having touched the *Rumex acetosa*, or *Ranunculus acris*.

Anthoxanthum odoratum. Sweet-scented Vernal-grass.

Specific character: Spike, egg-oblong shaped. Florets, longer than the awns, and supported on short foot-stalks.

Obs.—Blossom double, the outer one entirely different from that of any other of the grasses, its outside covered nearly to the top with stiff brown hairs lying flat. Stem with two or three short hairs and shining joints. Native of Britain. E. Bot. 647; Curt. Lond.; Wither. Arr.

Experiments.—The produce of herbage, from a space of four square feet of a brown sandy loam, with manure, on the 1st of April, is,

	dr.	qr.	oz.		lbs.		
Grass, 5 oz. 2 dr. The produce per acre	-	-	55811	0 =	3488	0	0
64 dr. of grass afford of nutritive matter -	1	3	1526	0 =	95	6	0
The produce of the space, ditto - -	2	$0\frac{31}{32}$					
At the time of flowering, the produce is,							
Grass, 11 oz. 8 dr. The produce per acre	-	-	125235	0 =	7827	3	0
80 dr. of grass weigh, when dry - -	$21\frac{1}{2}$	0	33656	0 =	2103	8	14
The produce of the space, ditto - -	49	$1\frac{7}{10}$					
The weight lost by the produce of one acre in drying			5723	10	2		
64 dr. of grass afford of nutritive matter -	1	0	1956	12 =	122	4	12
The produce of the space, ditto - - -	2	$3\frac{1}{10}$					
At the time the seed is ripe, the produce is,							
Grass, 9 oz. The produce per acre - -			98010	0 =	6125	10	0
80 dr. of grass weigh, when dry -	24	0	29403	0 =	1837	11	0
The produce of the space, ditto - -	43	$0\frac{1}{10}$					
The weight lost by the produce of one acre in drying			4287	15	0		
64 dr. of grass afford of nutritive matter	3	1	4977	1 =	311	1	1
The produce of the space, ditto - -	71	$0\frac{1}{4}$					
The weight of nutritive matter which is lost by taking the crop while the grass is in flower, exceeding one-half of its value, is - - - - -			188	12	5		
The proportional value which the grass, at the time the seed is ripe, bears to that at the time of flowering, is as 13 to 4.							
The produce of latter-math is,							
Grass, 10 oz. The produce per acre - - - - - -			108900	0 =	6806	4	0
64 dr. of grass afford of nutritive matter -	2 dr.	1 qr.	3828	8 =	239	4	8
The produce of the space, ditto -	3	$0\frac{32}{64}$					

The proportional value which the grass of the latter-math bears to that of the seed crop, is nearly as 13 to 9; and the proportional value or nourishment contained in the autumn grass, exceeds that of the first grass of the spring, as 9 to 7.

Sir H. Davy has shewn, that the nutritive matter of the grass at the time the seed is ripe, consists of—mucilage, or starch, 43, saccharine matter 4, and bitter extract and salt 3 = 50. The leaves, or first growth of the spring, afforded me of mucilage 40, saccharine matter 1, bitter extractive 9 = 50. The bitter extractive is here much greater in the leaves, than in the culms and leaves combined, which is the case with all the grasses I have made trial of, though in different proportions. This grass constitutes a part of the herbage of pastures on almost every kind of soil, though it only attains to perfection in those that are deep and moist. The chief property that gives merit to this grass is its early growth, though, in this respect, it is inferior

Anthoxanthum odoratum.

Sweet-scented Vernal-grass.

to several other species which are later in flowering. It thrives best when combined with many different species, and is therefore a true permanent pasture grass. It does not appear to be particularly liked by cattle, though eaten in pastures in common with others. Mr. Grant, of Leighton, laid down a field of considerable extent; one-half of which was sown with this grass and white clover, the other half with meadow foxtail and red clover. The sheep would not touch the sweet-scented vernal and white clover, but kept constantly on the foxtail-grass, though the dwarfish nature of the sweet-scented vernal had occasioned an unusual degree of luxuriance of the white clover, with which it was combined. This would indicate that it is not, when single, or when combined with but two or three different species, very grateful to cattle. The chemical examination of its nutritive matter, shews that it does not abound in saccharine matter, but chiefly in mucilage; and the insoluble extract is in a greater proportion than in many other grasses. Its merits, however, in respect to early growth, continuing to vegetate and throw up flowering stalks till the end of autumn, and its hardy and permanent nature, sufficiently uphold its claim to a place in the composition of all permanent pastures. The superior nutritive qualities of its latter-math, is a great recommendation for the purpose of grazing, the stalks being of but little utility, as they are generally left untouched by the cattle, provided there is a sufficiency of herbage.

It is said to give to new-mown hay that delightful smell which is peculiar to it; if it is not the sole cause of that pleasant smell, it is certainly more powerful when combined with the grasses which compose hay. About the middle of April it comes into flower, and the seed is ripe generally about the first or second week of June.

Dactylis glomerata. Round panicled Cock's-foot Grass.

Specific character: Panicle crowded, pointing one way; leaves keeled.

Native of Britain. E. Bot. 335; Host. t. 94; Mart. F. R. t. 14; F. D. 743; Moris. s. 8, t. 6, f. 38.

Experiments.—The produce of herbage, from a space of four square feet of a rich sandy loam, on the 15th of April, is,

	dr.	qr.	oz.		lbs.		
Grass, 15 oz. The produce per acre - - - -			163350	0 =	10209	6	0
64 dr. of grass afford of nutritive matter - -	2	1					
The produce of the space, ditto - - -	8	$1\frac{3}{4}$	5742	12 =	358	14	0
At the time of flowering, the produce is,							
Grass, 41 oz. The produce per acre - - - -			446490	0 =	27905	10	0
80 dr. of grass weigh, when dry - -	34	0					
The produce of the space, ditto - -	$278\frac{4}{5}$	0	189758	4 =	11859	14	4
The weight lost by the produce of one acre in drying - - - - - -			16045	11	12		
64 dr. of grass afford of nutritive matter -	2	2					
The produce of the space, ditto - -	25	$2\frac{1}{2}$	17441	0 =	1089	0	0
At the time the seed is ripe, the produce is,							
Grass, 39 oz. The produce per acre - - - -			424710	0 =	26544	6	0
80 dr. of grass weigh, when dry -	40	0					
The produce of the space, ditto - -	312	0	212355	0 =	13272	3	0
The weight lost by the produce of one acre in drying - - - -			13272	3	0		
64 dr. of grass afford of nutritive matter -	3	2					
The produce of the space, ditto - -	34	$0\frac{1}{2}$	23226	5 =	1451	10	5
The weight of nutritive matter, in which the seed crop exceeds that of the flowering crop, is,					362	10	5

Dactylis glomerata.

D

Round panicled Cock's-foot grass.

The proportional value which the grass, at the time the seed is ripe, bears to that at the time of flowering, is as 7 to 5. The produce of latter-math, is,

		oz.			lbs.	
Grass, 17 oz. 8 dr.	The produce per acre - - - -	190575	0	=	11910 15	0
64 dr. of grass afford of nutritive matter, 1 dr. 2 qr.	The produce per acre	4466	9	=	281 10	9

The proportional value which the grass, at the time of flowering, bears to that of the latter-math is, as 5 to 3; and the grass, at the time the seed is ripe, is to the latter-math as 7 to 3.

64 dr. of the culms, at the time of flowering, afford of nutritive matter, 1 dr. 2 qr. The leaves of cock's-foot, therefore, and its straws simply, are of equal proportional value; however, between the periods of flowering and perfecting the seed, the straws contain a much greater proportion of nutritive matter: 64 dr. of the culms at that stage of growth, afforded 3 dr. 1 qr. of nutritive matter. When cultivated on a peat soil, the produce was one-sixth greater, but the grass was of an inferior quality; 64 dr. of which afforded only 69 grains of nutritive matter, which proves the grass produced on a peat soil, to be inferior to that from a sandy loam, in the proportion of 9 to 8. The first leaves or herbage of the spring, is more nutritive than that produced at the end of autumn; 64 dr. at the beginning of April afforded 69 grains of nutritive matter, while the same quantity, in the month of November, afforded only 39 grains. It is deserving of particular notice, that the herbage of this grass, when suffered to grow rank, or old from want of sufficient stocking, contains nearly one-half less nourishment than that which is of a recent growth; 64 dr. of the leaves which had remained uncropped for four months, afforded only 20 grains of nutritive matter; while the same quantity of the leaves, two, or at most three weeks old, afforded 36 grains of nutrient matter. In the former grass, many of the leaves were withered and dry, and the rest rank, and of a dark green colour, while in the latter, they were all green and succulent. All these facts point out this grass to be more valuable for pasture than for hay: yet even for the latter purpose, it will be found more valuable than rye-grass (*Lolium perenne*), and many other grasses; proofs of which will be offered hereafter, when these grasses come under consideration. The above details prove that a loss of nearly one-third of the value of the crop is sustained, if it is left till the period the seed is ripe, though the proportional value of the grass at that time is greater. The produce does not increase if left standing after the time of flowering, but rather decreases in the weight of root-leaves; and the loss of latter-math, from the rapid growth of the foliage, after being cropped, is very considerable. This circumstance points out the necessity of keeping this grass closely cropped, either with cattle or the scythe, to reap the full benefit of its superior merits as a pasture grass; which will be more particularly pointed out hereafter, when speaking of the plants adapted for the alternate husbandry. Oxen, horses, and sheep, eat this grass readily. I have observed oxen eat the culms and flowering heads, till the time the seed was perfected. For the superiority of this grass over rye-grass, proved by an extensive cultivation of it, the agricultural world is indebted to Mr. Coke, of Norfolk. The seed was first collected in any considerable bulk, by Messrs. Gibbs, seedsmen to the Board of Agriculture.

Flowers from June till August, perfects its seed in July; or, if the herbage is eaten down till a late period of the spring, the seed does not ripen till August, or the beginning of September.

Alopecurus pratensis. Meadow Fox-tail Grass.

Specific character: Flowers in a spike; straw upright; calyx hairy; blossom awned.

Native of Britain, and most parts of Europe, from Italy, through France, Germany, Holland, to Denmark, Norway, Sweden, and Russia. Flo. Rust. E. Bot. 848; Wither. Arr.; Curt. Lond.; Hort. Kew.; Flo. Ger. It is surprising, observes Dr. Withering, that the specific character, in the latter editions of the works of Linnæus, should describe this grass as awnless: the awn is twice the length of the blossom, and knee bent.

Experiments.—The produce of herbage, from a space of four square feet of a clayey loam, on the 12th of April, is

	dr.	qr.	oz.		lbs.		
Grass, 14 oz. The produce per acre - - - -			152460	0 =	9528	12	0
64 dr. of grass afford of nutritive matter -	3	1	7742	0 =	483	14	0
The produce of the space, ditto - - -	11	1½					
At the time of flowering, the produce is,							
Grass, 30 oz. The produce per acre - - - -			326700	0 =	20418	12	0
80 dr. of grass weigh, when dry - -	24	0	98010	0 =	6125	10	0
The produce of the space, ditto - -	336	0					
The weight lost by the produce of one acre in drying - - - -			14293	2	0		
64 dr. of grass afford of nutritive matter -	1	2	7657	0 =	478	9	0
The produce of the space, ditto - -	11	1					
The produce from a sandy loam, is,							
Grass, 12 oz. 8 dr. The produce per acre - - - -			136125	0 =	8507	13	0
80 dr. of grass weigh, when dry - -	24	0	40837	8 =	2552	5	8
The produce of the space, ditto - -	60	0					
The weight lost by the produce of one acre in drying - - - -			5955	7	8		
64 dr. of grass afford of nutritive matter -	1	0	2126	15 =	132	14	15
The produce of the space, ditto - -	3	0½					
At the time the seed is ripe, the produce from a clayey loam is,							
Grass, 19 oz. The produce per acre - - - - -			206910	0 =	12931	14	0
80 dr. of grass weigh, when dry - -	36	0	93109	8 =	5819	5	8
The produce of the space, ditto - -	136	3⅓					
The weight lost by the produce of an acre in drying - - - -			7112	8	8		
64 dr. of grass afford of nutritive matter -	2	1	7274	2 =	454	10	2
The produce of the space ditto - -	10	2¾					

The weight of nutritive matter which is lost by leaving the crop till the seed be ripe, is 23 lbs. 14 oz. 14 dr. The proportional value which the grass, at the time the seed is ripe, bears to that at the time of flowering, is as 3 to 2. From a sandy soil, 64 dr. afforded 3 dr. of nutritive matter, which gives the superiority to the produce from a light soil over that from a clayey soil, as 4 to 3.

The latter-math produce from a clayey loam is,

	dr.	qr.	oz.		lbs.		
Grass, 12 oz. The produce per acre - - - -			130680	0 =	8167	8	0
64 dr. of grass afford of nutritive matter -	2	0	4083	12 =	255	3	12
The produce of the space ditto - - -	6	0					

The proportional value of the grass of the latter-math to that at the time of flowering, is as 24 to 13; and the crop, at the time the seed is ripe, is to that of the latter-math as 3 to 2.

Alopecurus pratensis.
E
Meadow Fox-tail grass.

The above details clearly shew, that there is nearly three-fourths of produce greater from a clayey loam than from a sandy soil, and that the grass from the latter soil is of comparatively less value, in the proportion of 3 to 2. The culms produced on the sandy soil are deficient in number, and in every respect smaller than those from the clayey loam; which satisfactorily accounts for the difference in the quantity of nutritive matter afforded by equal quantities of the grass. It is not the strength and rankness of the grass that indicates the fitness of the soil for its growth, but the number and quality of the culms. The proportional value in which the grass of the latter-math exceeds that of the flowering crop, is as 4 to 3; a difference which appears extraordinary, when the quantity of flowering culms in the flowering crop is considered. In the *Anthoxanthum odoratum*, the proportional difference between these crops is still greater, nearly as 9 to 4. In the *Poa trivialis* they are equal; but in all the later flowering grasses that have culms resembling those of the meadow foxtail and sweet-scented vernal, the greater proportional value is always, on the contrary, found in the grass of the flowering crop. Whatever the cause may be, it is evident that the loss sustained by taking these grasses at the time of flowering, is considerable. In ordinary cases this seldom happens in practice, because these grasses perfect their seed about the season when hay-harvest generally commences, unless where the pasture has been stocked till a late period of the spring, which cannot in this respect be productive of any ultimate advantage, but rather loss. This grass, under the best management, does not attain to its fullest productive powers till four years from seed: hence it is inferior to the cock's-foot grass for the purposes of alternate cropping, and to many other grasses besides. The herbage, however, contains more nutritive matter than that of the cock's-foot, though the weight of grass produced in one season is considerably less. It thrives well under irrigation, keeping possession of the crowns of the ridges: it is strictly permanent. Sheep are very fond of it; when combined with white clover only, the second season, on a sandy loam, it is sufficient for the support of five couple of ewes and lambs, per acre. As it only thrives in perfection on lands of an intermediate quality as to moisture and dryness, and also being somewhat longer in attaining to its full productive state than some other grasses, its merits have been misunderstood in many instances; and in others, as in the alternate husbandry, it has been by some persons set aside altogether. It constitutes the principal grass in all rich natural pastures. Though not so well adapted, therefore, for the alternate husbandry, it is one of the best grasses for permanent pasture, and should never form a less proportion than one-eighth of any mixture of different grasses prepared for that purpose: its merits demand this, whether with respect to early growth, produce, nutritive qualities, or permanency. It has been observed by the Rev. Mr. Swayne*, that nearly two-thirds of the seed is constantly destroyed by insects: according to my experiments, this evil may be almost entirely obviated, by suffering the first culms of the season to carry the seed. It flowers in April, May, and June, according as it may have been depastured earlier or later. Seed ripe in June and July, according to the season of flowering.

* See *Gramina Pascua*, by the Rev. G. Swayne, a work which contains much valuable information on the subject of grasses.

Poa pratensis. Smooth-stalked Meadow-grass.

Specific character: Panicle spreading; spikets, five-flowered, smooth. Straw erect, round. Root, creeping, perennial.

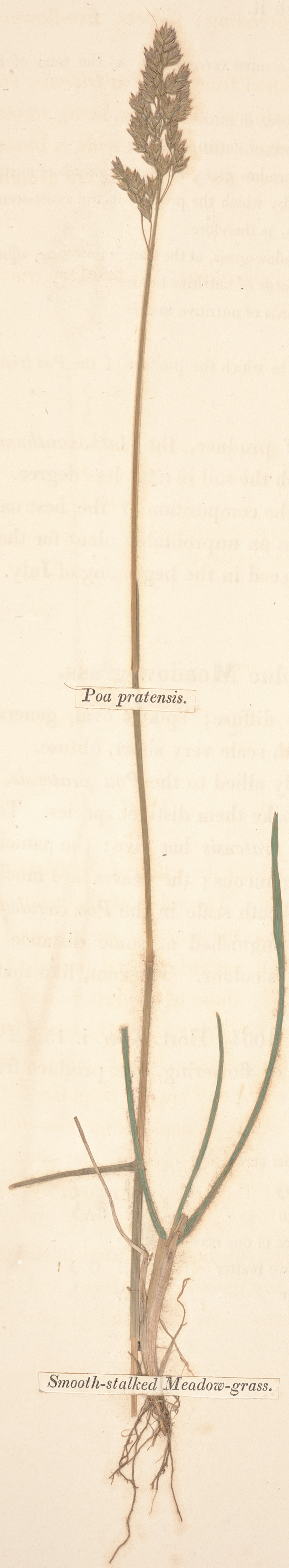
Obs.—This grass is distinguished from the *Poa trivialis,* smooth-stalked meadow-grass, by its strong creeping roots, sheaths of the straw being smooth; whereas in the *P. trivialis,* the sheaths are rough to the touch: the sheath scale is blunt; in the *Poa trivialis* it is pointed: the leaves are blunt; those of the *P. trivialis* are acuminate. E. Bot. 1073; Hort. Kew. i. p. 155; Curt. Lond.

Native of Britain.

Experiments.—At the time of flowering, the produce from a clayey loam rich with the vegetable matter of active peat, is

	dr.	qr.		oz.		lbs.		
Grass, 15 oz. The produce per acre, is - - - -				163350	0 =	10209	6	0
80 dr. of grass weigh, when dry - -	22	2	- -	45942	3 =	2871	6	3
The produce of the space, ditto - -	67	2						
The weight lost by the produce of one acre in drying - - - -				7337	15	13		
64 dr. of grass afford of nutritive matter -	1	3	- -	4466	9 =	279	2	9
The produce of the space, ditto - -	6	$2\frac{1}{10}$						
At the time the seed is ripe, the produce is,								
Grass, 12 dr. 8 oz. The produce per acre is, - - -				136125	0 =	8507	13	0
80 dr. of grass weigh, when dry - -	32	0	- -	54450	0 =	3403	2	0
The produce of the space, ditto - -	80	0						
The weight lost by the produce of one acre in drying - - - - -				5104	11	0		
64 dr. of grass afford of nutritive matter -	1	2	- -	3190	6 =	199	6	6
The produce of the space, ditto - -	4	$2\frac{3}{10}$						
The weight of nutritive matter which is lost, by leaving the crop till the seed be ripe, being nearly one-fourth of its value, is - - - - -				79	12	9		
The produce of latter-math is,								
Grass, 6 oz. The produce per acre - - - -				65340	0 =	4083	12	0
64 dr. of grass afford of nutritive matter -	1	3	- -	1786	10 =	111	10	0

The proportional value in which the grass of the latter-math exceeds that of the grass at the time the seed is ripe, is as 7 to 6. The value of the latter-math and seed crop are equal. This grass is therefore of least value at the time the seed is ripe; a loss of more than one-fourth part of the whole crop is sustained, if not cut till that period; the culms are then dry, and the root leaves in a sickly decaying state; those of the latter-math, on the contrary, are green and succulent. This species sends forth flowering straws but once in the season, and these being the most valuable part of the plant for the purposes of hay, and considering the superior value of the latter-math over that of the seed crop, it will appear from these properties to be well adapted for permanent pasture. There are, however, many other grasses highly superior to this one: it comes early in the spring; but the produce is inconsiderable, compared to many other grasses; its strong creeping roots exhaust the soil very much: after Midsummer the herbage is slow in growth after being cropped. It is the property of all creeping roots to scourge the soil, and when plants with fibrous roots can be substituted in the place of those, with an equal prospect of advantage in regard to early growth, produce, and nutritive qualities, it will be found to repay the labour with interest. As the chief property that gives value to this grass is early


Poa pratensis.
Smooth-stalked Meadow-grass.

growth, it will be of use to compare the merits of two other grasses which possess this property of early growth in common with it.

		lbs. per Acre.
Anthoxanthum odoratum. Sweet-scented vernal-grass, at the time of flowering, affords of nutritive matter	122	672
At the time the seed is ripe, affords of nutritive matter	311	
The produce of latter-math affords of nutritive matter	239	
Poa pratensis. Smooth-stalked meadow grass, as above, affords of nutritive matter		590
The weight of nutritive matter, by which the produce of the sweet-scented vernal exceeds that of the smooth-stalked meadow-grass, is therefore		82
Poa trivialis. Rough-stalked meadow-grass, at the time of flowering, affords of nutritive matter	233	792
At the time the seed is ripe, affords of nutritive matter	336	
The produce of latter-math affords of nutritive matter	223	
Poa pratensis. As before		590
The weight of nutritive matter, in which the produce of the *Poa trivialis* exceeds that of the *Poa pratensis*, is		202

Besides this superiority of produce, the *Anthoxanthum odoratum*, and *Poa trivialis*, have fibrous roots, which impoverish the soil in a far less degree. The *Poa pratensis* cannot therefore justify its claim to a place in the composition of the best natural pastures, and on this account should be carefully avoided, as an unprofitable plant for that purpose. It flowers in the beginning of June, and ripens the seed in the beginning of July.

Poa cærulea. Short blue Meadow-grass.

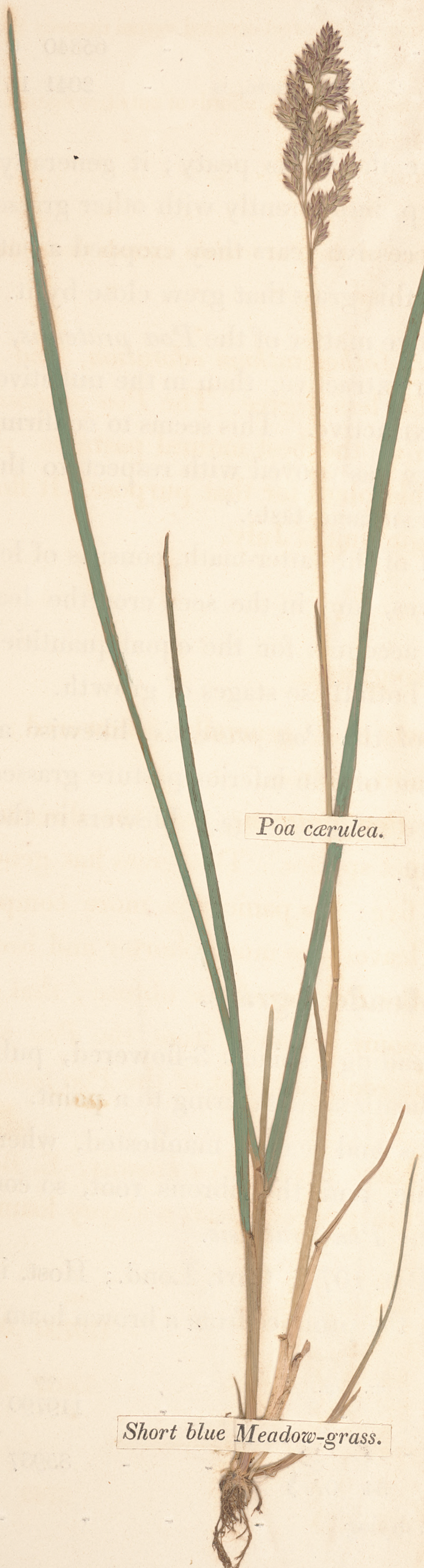
Specific character: Panicle diffuse; spikets oval, generally 3-flowered; husks acute, connected by a villus; sheath scale very short, obtuse.

Obs.—This grass is so nearly allied to the *Poa pratensis*, that the discriminating characters are hardly sufficient to make them distinct species. This grass has generally three florets in each calyx; the *Poa pratensis* has five: the panicle is more compact, the culms are shorter, and somewhat glaucous; the leaves are much shorter and broader than those of the *Poa pratensis*. The sheath scale in the *Poa cærulea* is obtuse; that of the *P. pratensis* is blunt. It may be distinguished at some distance from the *Poa pratensis*, by its delicate sky-blue or glaucous colour. The root, like that of the *Poa pratensis*, is powerfully creeping.

Native of Britain. E. Bot. 1004; Hort. Kew. i. 155, *Poa humilis;* E. Bot. *Poa subcærulea.*

Experiments.—At the time of flowering, the produce from a clayey loam enriched with bog earth, is

	dr.	qr.	oz.		lbs.		
Grass, 11 oz. The produce per acre			119790	0 =	7486	0	0
80 dr. of grass weigh, when dry	24	0					
The produce of the space, ditto	52	$3\frac{3}{16}$	35937	0 =	2246	0	0
The weight lost by the produce of one acre in drying			5240	13	0		
64 dr. of grass afford of nutritive matter	2	0					
The produce of the space, ditto	5	2	3743	7 =	233	15	7



Poa cærulea.

Short blue Meadow-grass.

	dr.	qr.	oz.		lbs.		
At the time the seed is ripe, the produce is,							
Grass, 8 oz. The produce per acre			87120	0 =	5445	0	0
80 dr. of grass weigh, when dry	20	0	21780	0 =	1361	4	0
The produce of the space, ditto	32	0					
The weight lost by the produce of one acre in drying					4083	12	0
64 dr. of grass afford of nutritive matter	2	0	2722	8 =	170	2	8
The produce of the space, ditto	4	0					
The produce of latter-math, is,							
Grass, 6 oz. the produce per acre			65340	0 =	4084	12	0
64 dr. of grass afford of nutritive matter	2	0	per acre, is 2041	14 =	127	9	14

This grass is common in meadows where the soil is peaty; it generally inhabits the drier parts. It is eaten by horses, oxen, and sheep, indifferently with other grasses; hares, however, prefer the *Poa pratensis* to this: for five successive years they cropped a patch of the *Poa pratensis,* and left untouched a similar space of this grass that grew close by it. The proportion of saccharine matter was greater, in the nutritive matter of the *Poa pratensis,* compared to that of the other constituents, mucilage, and bitter extractive, than in the nutritive matter of this species of *poa,* which contained more bitter extractive. This seems to confirm, with respect to the liking of the hare, what Sir Humphry Davy has proved with respect to the grasses most liked by cattle, "that they have either a saline or subacid taste."

The produce of the seed crop, and that of the latter-math, consists of leaves; in the flowering crop there are many decaying root leaves, and in the seed crop the leaves are more succulent, but the culms are perfectly dry: this accounts for the equal quantities of nutritive matter afforded by equal weights of the grass at both these stages of growth.

What was before said of the demerits of the *Poa pratensis,* likewise applies to this grass; and from the above facts, it is evidently one of the inferior pasture grasses, and cannot be recommended for cultivation with any prospect of advantage. Flowers in the beginning of June, and ripens the seed in the beginning of July.

Poa trivialis. Rough-stalked Meadow-grass.

Specific character: Panicle rather spreading; spikets 3-flowered, pubescent at the base; culm somewhat ascending, rough; sheath scale tapering to a point.

Obs. The great roughness of the culms and leaves, manifested, when drawn between the fingers; the sharp-pointed sheath scale, and the fibrous root, so conspicuous in this species, sufficiently distinguish it from the *Poa pratensis.*

Native of Britain; root perennial. E. Bot. 1072; Curt. Lond.; Host. ii. t. 62. Wither. Arr.

Experiments.—At the time of flowering, the produce from a brown loam with manure, is

	dr.	qr.	oz.		lbs.		
Grass, 11 oz. The produce per acre			119790	0 =	7486	14	0
80 dr. of grass weigh, when dry	24	0					
The produce of the space, ditto	54	$0\frac{3}{10}$	35937	0 =	2246	1	0
The weight lost by the produce of one acre in drying					5240	13	0

Poa trivialis.

Rough-stalked Meadow-grass.

	dr.	qr.	oz.		lbs.		
64 dr. of grass afford of nutritive matter -	2	0	3743	10 =	233	15	10
The produce of the space, ditto - -	5	2					
At the time the seed is ripe, the produce is,							
Grass, 11 oz. 8 dr. The produce per acre - - - - -			125235	0 =	7827	3	0
80 dr. of grass weigh, when dry - -	36	0	56355	12 =	3522	3	12
The produce of the space, ditto - -	82	$3\frac{1}{7}$					
The weight lost by the produce of one acre in drying - - - - - -			4304	15	0		
64 dr. of grass afford of nutritive matter -	2	3	5381	3 =	336	5	3
The produce of the space, ditto - -	7	$3\frac{5}{8}$					
The weight of nutritive matter which is lost by taking the crop at the time of flowering, exceeding one-fourth of its value, is - - - - -			102	5	12		

The proportional value in which the grass of the seed crop exceeds that at the time of flowering, is as 8 to 11.

The produce of latter-math is,

Grass, 7 oz. The produce per acre - - - - -	76230	0 =	4764	6	0	
64 dr. of grass afford of nutritive matter - 3 dr. per acre -	3573	4 =	223	5	4	

The proportional value in which the grass of the latter-math exceeds that of the flowering crop, is as 3 to 2, and that of the seed crop as 12 to 11.

Here then is a satisfactory proof of the superior value of the crop at the time the seed is ripe, and of the consequent loss sustained by taking it when in flower; because, in this instance, the weight of each crop is nearly the same, and the latter-math which would be produced in the time that is taken up in perfecting the seed, is infinitely less than that of many other species of grass, where the loss of latter-math, under such circumstances, would far outweigh any superiority of the nutritive qualities of the crop at the time the seed is ripe, if such superiority was great, which is seldom found.

The weight of hay produced from the grass of the flowering crop is much less, in proportion to that formed by an equal weight of the grass of the seed crop. In Mr. Young's Annals of Agriculture we are informed, that so long ago as the year 1785, Mr. Boys, of Betshanger, in Kent, a farmer of the highest reputation, raised, at much expence, and several years' attention, from twenty to thirty bushels of the seed of this grass, which he then offered for sale at three shillings per pound. He says that it makes a very fine thick turf, and will produce a great quantity of very excellent grass from moist rich soils. He used the straw after the seed was thrashed, instead of hay, for his riding horses, and they preferred it to his best meadow hay. To have the land covered thick, more than seven pounds of seed should be sown to the acre. Dr. Smith observes, that it does not bear the frost so well, nor does it shoot so early in the spring, as the *Poa pratensis;* but when the weather becomes warm enough to make grasses in general shoot, this grows faster, and produces a greater crop of bottom leaves, than most others. The experiments above detailed were made before I met with the observations of Mr. Young and Dr. Smith, just quoted, and all my observations tend to confirm those opinions concerning this grass.

The superior produce of this *Poa* over many other species, its highly nutritive qualities, the seasons in which it arrives at perfection, and the marked partiality which oxen, horses, and sheep have for it, are merits which distinguish it as one of the most valuable of those grasses which affect moist rich soils and sheltered situations: but on dry exposed situations it is altoge-

ther inconsiderable ; it yearly diminishes, and ultimately dies off, not unfrequently in the space of four or five years. Its produce* is always much greater when combined with other grasses than when cultivated by itself: with a proper admixture it will nearly double its produce, though on the same soil, so much it delights in shelter. Those spots in pastures that are most closely eaten down, consist for the most part of this grass: I have examined many pastures with this view, and always found it the case wherever this grass was more predominate. From all which it appears, that the *Poa trivialis*, though highly valuable as a permanent pasture grass on rich and sheltered soils, is but little adapted for the alternate husbandry, and unprofitable for any purpose on dry exposed situations. It flowers towards the end of June, and ripens the seed in the middle of July.

* According to the account which is given of this grass by Mr. Swayne, in Dr. Withering's Arrangement of British Plants, it is the famous Orcheston grass.—I am surprised to find it remarked of this grass so long back as 1681, that "at Maddington, in Wiltshire, about nine miles from Salisbury, grows a grass, in a small plot of meadow ground, which grass in some years grows to a prodigious length, sometimes twenty-four feet long, but not in height, as is usually reported; the length being caused by the washing of a sheep-down, that the rain in a hasty shower brings with it much of the sheep dung over the meadow; so that in such springs as are not subject to such showers, this grass thriveth not so well." *Woldridge.*—The report of a grass growing twenty-four feet in height, must have excited no ordinary attention.

Festuca pratensis. Meadow Fescue.

Specific character: Panicle slanting, pointing one way; spikets awnless, nearly strap-shaped; leaves flat.

Native of Britain. Root fibrous, perennial.

Obs.—Dr. Withering makes this a variety of the *Festuca elatior;* but it is more justly made a distinct species in the English Botany. It differs from the *Festuca elatior* in having only half the height, the leaves only half the breadth, the panicle shorter, and containing only half the number of flowers. The panicle is but once branched, droops but slightly, and leans to one side when in flower, and the flowers grow all one way: in the *Elatior*, the panicle branches both ways; it droops much at first, and the flowers grow much more loosely. The spikets are more round, ovate, and pointed, whereas in the *Pratensis* they are somewhat linear, flat, and obtuse. Curt. Lond.; E. Bot. 1592; Wither. Arr.; Hort. Kew. i. p. 165.

Experiments.—On the 16th of April, the produce from a fertile peat soil, with coal-ashes as manure, is

	dr.	qr.		oz.		lbs.		
Grass, 16 oz. The produce per acre - - - - -				174240	0 =	10890	0	0
64 dr. of grass afford of nutritive matter -	2	1	per acre -	6125	0 =	382	13	10
The produce of the space, ditto - - -	9	0						
At the time of flowering, the produce is,								
Grass, 20 oz. The produce per acre - - - -				217800	0 =	13612	8	0
The produce of the space, ditto, when dry -	152	0	- -	103455	0 =	6465	15	0
80 dr. of grass weigh, when dry - -	38	0						
The weight lost by the produce of one acre in drying - - - -				7146	9	0		
64 dr. of grass afford of nutritive matter -	4	2	- -	15314	1 =	957	2	1
The produce of the space, ditto - -	22	2						
At the time the seed is ripe, the produce is,								
Grass, 28 oz. The produce per acre - - - -				304920	0 =	19057	8	0
80 dr. of grass weigh, when dry - -	32	0	- -	121968	0 =	7623	0	0
The produce of the space, ditto - -	179	$0\frac{4}{5}$						
The weight lost by the produce of one acre in drying - - - -				11434	8	0		
64 dr. of grass afford of nutritive matter -	1	2	- -	7146	9 =	446	10	9
The produce of the space, ditto - -	10	2						
The weight of nutritive matter which is afforded by the produce of latter-math per acre, is -				380	0	0		
The weight of nutritive matter which is lost by leaving the crop till the seed is ripe, exceeding one-half of its value, is - - - - - - - -				510	7	8		

The grass at the time of flowering, is of greater value than that at the time the seed is ripe, proportionally, as 9 to 3.

The weight of nutritive matter which is lost by leaving the crop of this grass till the seed be ripe, is therefore very great. That it should lose more of its weight at this stage of growth than at the time of flowering, perfectly agrees with the deficiency of nutritive matter in the seed crop, in proportion to the nutritive matter afforded by the flowering crop; the straws being succulent in the grass of the latter crop, while those of the former are dry, and constitute a much smaller proportion of the weight of the crop than in the flowering crop. It may be

Festuca pratensis.
H
Meadow Fescue.

observed here, that there is a great difference between culms and leaves of grasses that have been dried after they were cut in a green and succulent state, or in possession of their nutrient qualities, and those culms and leaves which have been dried (if I may so express it) by Nature when growing: the former retain all their nutritive powers, but the latter very little, if any. In point of early produce in the spring, this grass stands next to the *Alopecurus pratensis*, (meadow foxtail), and is superior in this respect to the cock's-foot.

	lbs.
About the middle of April, the meadow-foxtail affords of nutritive matter, per acre - - -	483
At the same season, the meadow-fescue, as above, affords of nutritive matter, per acre - -	382
The round-panicled cock's-foot, *(Dactylis glomerata)*, ditto ditto - - - -	358

It is eaten by horses, oxen, and sheep, but particularly by the two first: its merits will be more clearly seen by comparing it farther with the cock's-foot and meadow-foxtail. As it is often three weeks later in flowering than the foxtail-grass, the latter-math produce must be left out for the truth of comparison; and as it is much slower in growth after being cropped than the cock's-foot, it is likewise necessary to omit the latter-math in a comparison of their produce.

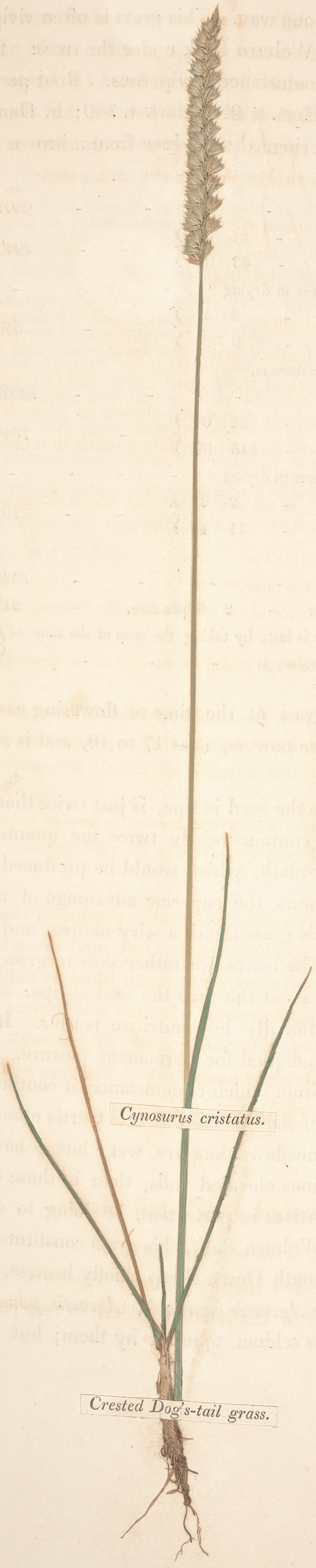
	lbs.	
Alopecurus pratensis, (meadow-foxtail), at the time of flowering, affords of nutritive matter, per acre - - - - - - - - - - -	487	1194
At the time the seed is ripe, ditto ditto ditto - - - - - - -	461	
The produce of latter-math, ditto ditto ditto - - - - - - -	255	
The *Festuca pratensis*, (meadow-fescue), as above, affords, from the flowering and seeding crops only - - - - - - - - - - - -		1403
The weight of nutritive matter in which the produce of one acre of the meadow-fescue exceeds that of the foxtail, is - - - - - - - - - -		209
Or the meadow-fescue is of greater value than that of the foxtail, in the proportion nearly of 11 to 9.		
Dactylis glomerata, (round cock's-foot, affords of nutritive matter, per acre, from three crops, that is, at the time of flowering, at the time of seeding, and from the latter-math crop, as before		2821
The *Festuca pratensis*, as above - - - - - - - - - - - - - -		1403
The weight of nutritive matter, in which the cock's-foot exceeds the meadow-fescue per acre, is -		1418
Or the cock's-foot grass is superior, in point of produce, to the meadow-fescue, in the proportion nearly of 2 to 1.		

The meadow-fescue constitutes a very considerable portion of the herbage of all rich natural pastures and irrigated meadows; it makes excellent hay, and though a large plant, the leaves or herbage are succulent and tender, and apparently much liked by cattle, as they never form rank tufts, which is the case with the larger grasses. It does not appear to arrive at perfection from seed so soon as either the cock's-foot or foxtail grasses, and though essential for permanent pasture, is not well adapted for the alternate husbandry. Flowers in June, and ripens the seed at the end of July and the beginning of August.

Cynosurus cristatus. Crested Dog's-tail Grass.

Specific character: Floral leaves with winged clefts.

Obs.—Floral leaves deeply divided into awl-shaped segments. Husks generally containing three flowers. Smaller valve of the blossom ending in two points: larger valve ending in



Cynosurus cristatus.

Crested Dog's-tail grass.

a short awn. Florets all facing one way. This grass is often viviparous; in wet seasons, I have found it generally so, in Woburn Park under the trees. I have found the *Alopecurus pratensis* under the like circumstances viviparous. Root perennial.

Native of Britain. E. Bot. 316; Host. t. 96; Mart. t. 106; F. Dan. 238.

Experiments.—At the time of flowering, the produce from a brown loam, with manure, is,

	dr.	qr.	oz.		lbs.		
Grass, 9 oz. The produce per acre, is - - - -			98010	0 =	6125	10	0
80 dr. of grass weigh, when dry - -	24	0	29403	0 =	1837	11	0
The produce of the space, ditto - -	43	$0\frac{4}{5}$					
The weight lost by the produce of one acre in drying - - - -					4287	15	0
64 dr. of grass afford of nutritive matter -	4	1	6508	3 =	406	12	3
The produce of the space, ditto - -	9	$2\frac{1}{4}$					
At the time the seed is ripe, the produce is,							
Grass, 18 oz. The produce per acre, - - -			196020	0 =	12251	4	0
80 dr. of grass weigh, when dry - -	32	0	78408	0 =	4900	0	0
The produce of the space, ditto - -	115	$0\frac{4}{5}$					
The weight lost by the produce of one acre in drying - - - - -					7350	12	0
64 dr. of grass afford of nutritive matter -	2	2	7657	0 =	478	9	0
The produce of the space, ditto - -	11	1					
The produce of latter-math is,							
Grass, 5 oz. The produce per acre - - - -			54450	0 =	3403	2	0
64 dr. of grass afford of nutritive matter -	2	2 per acre, -	2126	0 =	132	14	0
The weight of nutritive matter which is lost, by taking the crop at the time of flowering, exceeding one-sixth of its value, is - - -					71	12	9

The proportion in which the grass at the time of flowering exceeds that at the time the seed is ripe, with respect to nutritive powers, is as 17 to 10, and is superior to the latter-math in the like proportion.

The quantity of grass at the time the seed is ripe, is just twice that at the time of flowering; but the grass at the former period contains nearly twice the quantity of nutritive matter, as appears above; and when the latter-math, which would be produced during the time the seed was ripening, is added to this, it shews the superior advantage of taking the crop when the grass is in flower. The culms of this grass are of a wiry nature, and, at the time the seed is ripe, contain no nutritive matter. The leaves are rather slow in growth, are short, but form a dense turf; hence, the weight of grass at the time the seed is ripe, is greater than at the time of flowering, but contains proportionally less nutritive matter. It is therefore inferior for the purpose of hay, but admirably adapted for permanent pasture. The roots penetrate to a considerable depth in the ground, from which circumstance, it continues green after most other grasses are hurt by a continuance of dry weather. Mr. Curtis observes, that it affects a dry soil, and that it will not thrive in meadows that are wet; but I have always found it more abundant in moist, or rather tenacious elevated soils, than in those of a drier and more sandy nature. In irrigated meadows it thrives in perfection, attaining to a greater size than in any other situation. In some parts of Woburn Park, this grass constitutes the principal part of the herbage, on which the deer and South Down sheep chiefly browse, while another part of the Park, which consists chiefly of the *Agrostis capillaris*, *Agrostis pumila*, *Festuca ovina*, *Festuca duriuscula*, and *Festuca cambrica*, is seldom touched by them; but the Welsh breed of sheep

almost constantly browse on these, and almost entirely neglect the *Cynosurus cristatus*, *Lolium perenne*, and *Poa trivialis*. The Welsh breed of sheep not being bred in the Park, this preference to particular grasses must be the effect of something else than habit. There has been a difference of opinion with respect to the merits of this grass: it certainly does not afford so early a bite to cattle in the spring as many other grasses, and the culms are uniformly left untouched; but this is more owing to the season in which they are produced, than to any particular defect; as there is then a profusion of root leaves and herbage in general, which is always preferred by cattle to the culms: when the grass is in flower, the culms are succulent, and contain much nutritive matter; it is all, however, exhausted in perfecting the seed. If this grass is employed only for the alternate husbandry, and its merits from thence estimated, it will be considered an inferior grass, as it is by no means adapted for that purpose, either with respect to speedily arriving at perfection, early growth, or quantity of produce; but its forming a close dense turf of grateful nutritive herbage, and being little affected by the extremes of weather, where other grasses, superior in the fore-mentioned points would be produced in tufts, and injured by the extremes of weather. From these facts it is evident, a sward of the best quality, particularly under circumstances where sheep are a principal object, cannot be formed without an admixture or proportion of the crested dog's-tail grass. It flowers towards the end of June, and ripens the seed towards the end of July.

Festuca duriuscula. Hard Fescue.

Specific character: Panicle oblong; spikets oblong; root-leaves bristle-shaped; stem-leaves flat.

Obs.—Dr. Smith observes, "That in this genus it is hard to say what may, or what may not be a species; and he reduces the *Festuca glauca, Festuca glabra, Festuca cambrica, Festuca duriuscula,* and *Festuca rubra,* of Hudson, Lightfoot, Withering, Winch, and Stillingfleet, &c. into one species. All these grasses vary much from change of soil and situation; the flowers are particularly apt to vary in number, as well as in the length of their awns: there is one character, however, which I have never found to change under any variety of culture, which is the creeping root; and this is also an agricultural character of distinction which is never to be lost sight of, as it always produces a *specific* effect upon the soil, very distinct indeed from that of the fibrous-rooted kinds. The botanical characters given by the learned, being therefore insufficient to distinguish these grasses, (which I have no doubt will be equally so with all the present specific distinctions of plants, when discoveries have been sufficiently extended over every country), I will here consider them of two *distinct* species—the creeping-rooted, and the fibrous-rooted—noting their varieties from other parts of the plant. This will be sufficient for the purposes of the Agriculturist, and the botanical difficulties may with safety be left out of his consideration; or at least, to practical men, they will be much less embarrassing, and obviate in a great measure, in these plants, the danger of mistake. See E. Bot. 470-2056; With. Still. Curtis. Lond.

Root fibrous. Perennial.

Experiments.—At the time of flowering, the produce from a clayey loam with manure, is,

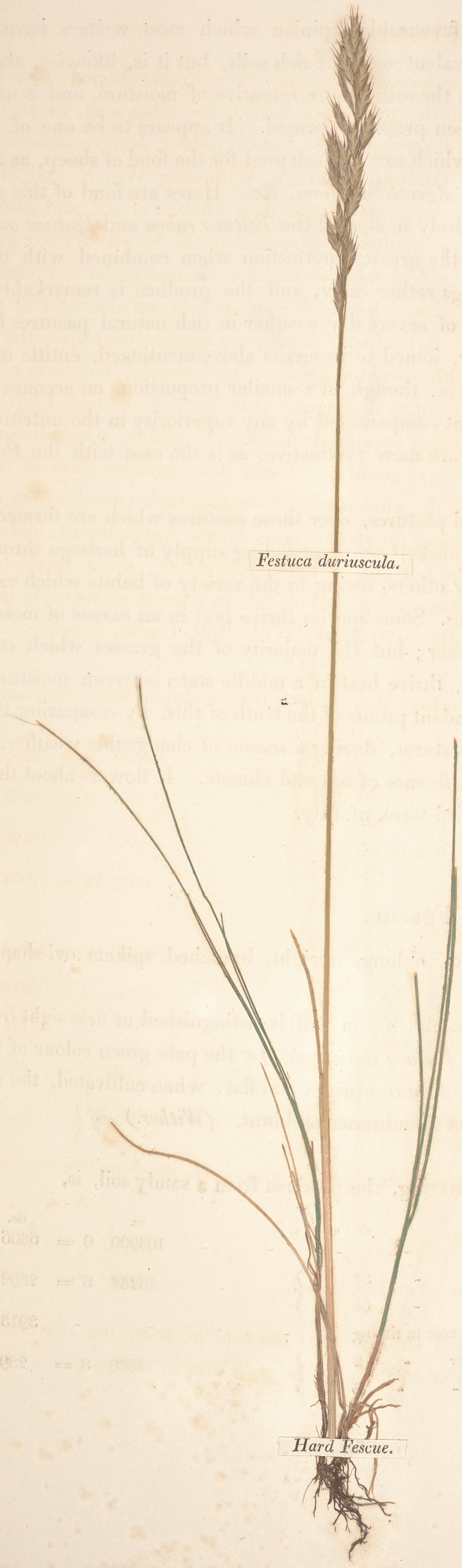
	dr.	qr.		oz.		lbs.		
Grass, 27 oz. The produce per acre is - - - - -				294030	0 =	18376	14	0
80 dr. of grass weigh, when dry - -	36	0	- -	132313	8 =	8269	9	8
The produce of the space, ditto - -	194	$1\frac{3}{5}$						
The weight lost by the produce of one acre in drying - - - -						10106	4	8
64 dr. of grass afford of nutritive matter -	3	2	- -	16079	12 =	1004	15	12
The produce of the space, ditto - -	23	$2\frac{1}{2}$						
At the time the seed is ripe, the produce is								
Grass, 28 oz. The produce per acre - - - -				304920	0 =	19057	8	0
80 dr. of grass weigh, when dry - -	36	0	- -	137214	0 =	8575	14	0
The produce of the space, ditto - -	201	$2\frac{2}{5}$						
The weight lost by the produce of one acre in drying - - - -						10481	10	0
64 dr. of grass afford of nutritive matter -	1	2	- -	7146	9 =	446	10	9
The produce of the space, ditto - - -	10	2						
The weight of nutritive matter which is lost by leaving the crop till the seed is ripe, exceeding one-half of its value, is - - - - - - - - -						558	5	3

The proportional value in which the grass, at the time of flowering, exceeds that at the time the seed is ripe, is as 7 to 3.

The produce of latter-math is,

Grass, 15 oz. The produce per acre - - - - -	163350	0 =	10209	6	0
64 dr. of grass afford of nutritive matter, 1 dr. 1 qr. per acre - -	3190	4 =	199	6	4

The proportional value in which the grass, at the time of flowering, exceeds that of the latter-math, is as 14 to 5; and to that at the time the seed is ripe, as 6 to 5.



Festuca duriuscula.

Hard Fescue.

The above details confirm the favourable opinion which most writers have expressed respecting this grass. It is most prevalent on light rich soils, but it is, likewise, always found in the richest natural pastures, where the soil is more retentive of moisture, and is never absent from irrigated meadows that have been properly formed. It appears to be one of the best of the fine, or dwarf-growing grasses, which are best adapted for the food of sheep, as the *Festuca ovina, Festuca rubra, Poa pratensis, Agrostis vulgaris*, &c. Hares are fond of this grass, they cropped it close to the roots, and entirely neglected the *Festuca rubra* and *Festuca ovina*, which grew contiguous to it. It attains to the greatest perfection when combined with the *Festuca pratensis* and *Poa trivialis*. It springs rather early, and the produce is remarkably fine and succulent. It withstands the effects of severe dry weather in rich natural pastures better than many other grasses. This property, joined to its merits above-mentioned, entitle it to a place in the composition of the best pastures, though in a smaller proportion, on account of its inferior productive powers, which are not compensated by any superiority in the nutritive qualities of the grass over those grasses that are more productive, as is the case with the *Poa trivialis*, and some other species.

The superiority of these natural pastures, over those pastures which are formed of one or two grasses only, in respect of a constant or never-failing supply of herbage throughout the season, is in one point, among many others, owing to the variety of habits which exist in a numerous assemblage of different grasses. Some species thrive best in an excess of moist weather; others, in a continuance of dry weather; but the majority of the grasses which compose the produce of the pastures in question, thrive best in a middle state between moisture and dryness. Observation will furnish abundant proofs of the truth of this, by comparing the different states of productiveness in natural pastures, during a season of changeable weather, with those of artificial pastures under the like influence of soil and climate. It flowers about the middle of June, and ripens the seed in the third week of July.

Festuca cambrica. Welsh Fescue.

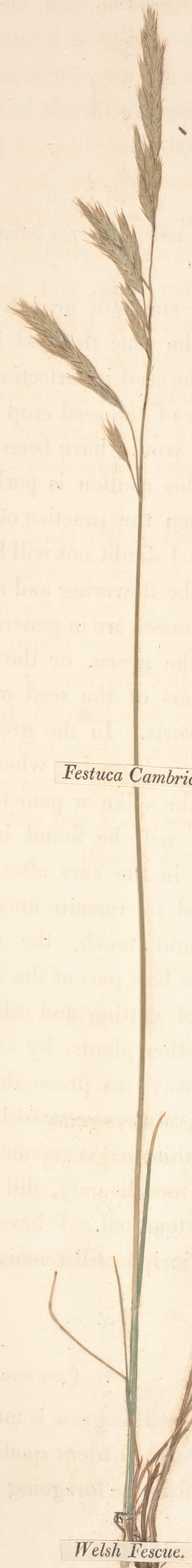
Specific character: Panicle compact, oblong, upright, branched, spikets awl-shaped, awned, leaves flat.

Obs.—This species (or constant variety, if you will) is distinguished at first sight from the *Festuca ovina, Festuca rubra*, and *Festuca duriuscula*, by the pale green colour of the panicle and culm. The root leaves grow more upright and flat; when cultivated, the spikets consist of 10 or 12 florets. Stipulæ membraneous, blunt. *(Wither.)*

Root fibrous. Perennial.

Experiments.—At the time of flowering, the produce from a sandy soil, is,

	dr.	qr.		oz.		lbs.		
Grass, 10 oz. The produce per acre - - - -				108900	0 =	6806	4	0
80 dr. of grass weigh when dry - -	34	0	}					
The produce of the space, dittto - -	68	0	} -	46282	8 =	2892	10	8
The weight lost by the produce of one acre in drying - - - -						3913	9	8
64 dr. of grass afford of nutritive matter -	2	1	}					
The produce of the space, ditto - -	5	2½	} -	3828	8 =	239	4	8



Festuca Cambrica.

Welsh Fescue.

	dr.	qr.	oz.		lbs.		
At the time the seed is ripe, the produce is,							
Grass, 20 oz. The produce per acre - - - -			217800	0 =	13612	8	0
80 dr. of grass weigh when dry - -	24	0	65340	0 =	4083	12	0
The produce of the space, ditto - -	96	0					
The weight lost by the produce of one acre in drying - - - - - - -					9528	12	0
64 dr. of grass afford of nutritive matter -	2	1	7657	0 =	478	9	0
The produce of the space, ditto - -	11	1					
The weight of nutritive matter which is lost by taking the crop before the seed is perfected, being one-half of its value, is, - - - - -					239	4	2

The value of the grass at each of these stages of growth is equal. The superior weight of nutritive matter afforded by the crop at the time the seed is ripe, arises from the increase of grass which takes place during the time the seed is perfecting; and in this case as in all others, where it is shewn that the nutritive matter of the seed crop exceeds that contained in the flowering crop, the loss of latter-math which would have been produced in the time the seed was perfecting, must always be considered: this caution is perhaps unnecessary to the *judicious*, candid, and truly practical Farmer. When the practice of saving the necessary quantity of seed for the farm becomes general, (which I doubt not will happen, though at a remote period), these comparisons between the value of the flowering and seed crops will possess their proper interest. The seed crops of the natural grasses are in general, at least as far as my observations have reached, left too long growing; the green, or the withered state of the culms, is an uncertain criterion to judge of the ripeness of the seed of the *perennial* grasses, though generally good for the different *annual* sorts. In the greater part of the perennial grasses, the culms are far from being either withered or dry when the seed is ripe, which is determined, in almost all cases, by passing the spike or panicle between the fingers; if a portion of the seed separate by this means, it will be found in the best state for collecting; it should, however, be suffered to remain in the ears after being cut, until the grass be perfectly dry. When the grass is suffered to remain uncut till the culms are withered and dry, and the seed separates on a slight touch, the grass is rendered of little value, and the seed not improved in quality; the best part of the seed is either lost by devouring birds, or insects, or shaken out in the process of cutting and collecting. I have made a number of experiments on the seeds of grasses and other plants, by sowing at different degrees of what is termed ripeness, and the results went always to prove the truth of the above remarks; also that diseased or imperfectly formed seed, always vegetated best when sown directly after being separated from the plant. An ounce of this seed vegetated, by this treatment, in three different trials; the same seed, kept dry for two months only, did not vegetate by the like means employed in sowing, or any other that I attempted. I have repeated experiments of this nature with much interest and care, but the principle still remained unaltered.

The produce of latter-math is,

	dr.	qr.	oz.		lbs.		
Grass, 9 oz. The produce per acre - - - - -			98010	0 =	6125	10	0
64 dr. of grass afford of nutritive matter -	1	1 per acre -	7914	0 =	119	0	0

From the above results it appears, that this grass is much inferior to the *Festuca duriuscula*, in the quantity of its produce, as well as in nutrient qualities, which will be evident on a comparison of these properties, as mentioned in the foregoing details. It springs rather earlier than

the hard fescue, and also rises better after being cropped, but not, apparently, in a sufficient degree to compensate for its deficiencies in other respects. It is far from being so common as the *F. duriuscula,* and inhabits the drier spots of pastures. Flowers some days earlier than the *F. duriuscula,* and ripens the seed about the same period as that grass.

Festuca ovina hordiformis. Long-awned Sheep's Fescue.

Specific character: Panicle compact, branches subdivided, upright. Spikets crowded, 6-10 flowered. Root-leaves thread-shaped, stem-leaves very long.

Obs.—In the first account of the results of these experiments, this grass is received under the name of *Festuca hordiformis:* though there are names received among Botanists, not less incongruous than this one, yet I am happy to agree with the opinion of Mr. Sowerby, in considering it a variety of the *Festuca ovina.* I am uncertain as to its native place of growth, having never discovered it in any soil or situation in a wild state. The culms are strongly marked with ribs.

Root fibrous, perennial. Native of Britain.

Experiments.—At the time of flowering, the produce from a sandy soil with manure, is,

	dr.	qr.	oz.		lbs.		
Grass, 20 oz. The produce per acre - - -			217800	0 =	13612	8	0
80 dr. of grass weigh, when dry - -	24	0	65340	0 =	4083	12	0
The produce of the space, ditto - -	96	0					
The weight lost by the produce of one acre in drying - - - - - -					9528	12	0
64 dr. of grass afford of nutritive matter -	2	1	7657	0 =	478	9	0
The produce of the space, ditto - - -	11	1					
At the time the seed is ripe, the produce is,							
Grass, 14 oz. the produce per acre - - - - -			152460	0 =	9528	12	0
80 dr. of grass weigh, when dry - - -	32	0	60984	0 =	3811	8	0
The produce of the space, ditto - -	89	$2\frac{2}{5}$					
The weight lost by the produce of one acre in drying - - - -					5717	4	0
64 dr. of grass afford of nutritive matter -	1	3	4168	13 =	260	13	0
The produce of the space, ditto - - -	6	$0\frac{3}{4}$					
The produce of latter-math, is,							
Grass, 8 oz. The produce per acre - - - -			87120	0 =	5445	0	0
64 dr. of grass afford of nutritive matter -	1	3 per acre -	2382	3 =	148	14	0
The weight of nutritive matter which is lost by leaving the crop till the seed be ripe, exceeding one-half of its value, is - - - - - - - -					217	12	

The proportional value in which the grass at the time of flowering, exceeds that at the time the seed is ripe, is as 9 to 7, and it exceeds the value of the latter-math grass in the like proportion. The grass of the seed crop, and that of the latter-math, are equal in the quantity of nutritive matter they contain; a circumstance easily accounted for, as the culms at the time the seed is ripe, are drier than in most other grasses at the same stage of growth, and the produce then consists almost entirely of leaves, similar to the latter-math produce. This species flowers earlier than any other of the fescue species. Its nutritive qualities are nearly the same as those of the *Festuca duriuscula.* It is superior to that species, and to most others, in the produce of early herbage in the spring; the herbage is very fine, tender, and succulent. It is highly superior to the *Festuca ovina,* of which it is considered a variety. It does not appear, however, to possess any merit in a sufficient degree to entitle it to a place in the composition of the best natural pastures, unless as a substitute for the *Festuca duriuscula,* which might be effected with advantage on soils of a drier, or sandy nature. It flowers in the last week of May, and ripens the seed in June.

Festuca ovina hordiformis.

Long-awned Sheep's Fescue.

Avena flavescens. Golden Oat, Yellow Oat-grass.

Specific character: Panicle loose; calyx 3-flowered, short, all the florets awned.

Root fibrous, perennial. Native of Britain.

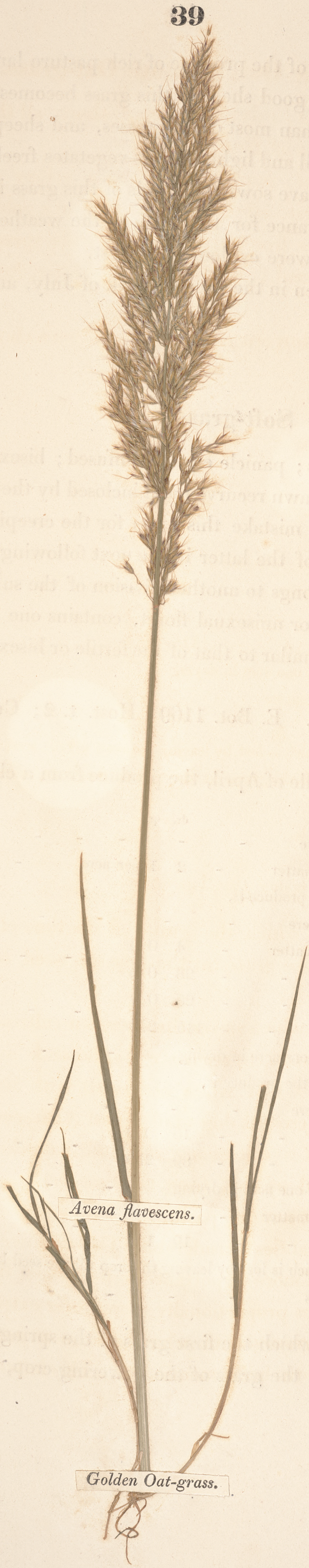
Obs.—Leaves linear, acute, flat; margin rough, of a yellow green colour. Panicle much branched, yellow green at first, afterwards changing to a golden yellow, by which it may be distinguished at a distance from other grasses; wide spread when in flower, but compact when in seed. Curt. Lond.; E. Bot. t. 952; Wither. Arr.; Host. t. 38; Flo. Germ. i. p. 377; Hort. Kew.

Experiments.—At the time of flowering, the produce from a clayey loam, is,

	dr.	qr.		oz.		lbs.		
Grass, 12 oz. The produce per acre - - - - - -				130680	0 =	8167	8	0
80 dr. of grass weigh, when dry - -	28	0	- -	45738	0 =	2858	10	0
The produce of the space, ditto - - -	67	$0\frac{4}{5}$						
The weight lost by the produce of one acre in drying - - - - - - -				5308	14	0		
64 dr. of grass afford of nutritive matter -	3	3	- -	7657	0 =	478	9	0
The produce of the space, ditto - -	11	1						
At the time the seed is ripe, the produce is,								
Grass, 18 oz. The produce per acre - - - - - -				196020	0 =	12251	4	0
80 dr. of grass weigh, when dry - -	32	0	- -	78408	0 =	4900	8	0
The produce of the space, ditto - -	115	$0\frac{4}{5}$						
The weight lost by the produce of one acre in drying - - - -				7350	12	0		
64 dr. of grass afford of nutritive matter -	2	1	- - -	6891	5 =	430	11	5
The produce of the space, ditto - -	10	$0\frac{1}{2}$						
The weight of nutritive matter which is lost by leaving the crop till the seed be ripe, is -				47	13	11		
The proportional value in which the grass, at the time of flowering, exceeds that at the time the seed is ripe, is as 5 to 3.								
The produce of latter-math, is,								
Grass, 6 oz. The produce per acre - - - - -				65340	0 =	4083	12	0
64 dr. of grass afford of nutritive matter 1 dr. 1 qr. per acre - -				1276	2 =	79	12	2

The proportional value in which the grass, at the time of flowering, exceeds that of the latter-math, is as 3 to 1; and the grass, at the time the seed is ripe, is to that of the latter-math, as 9 to 5.

This is one of those grasses which never thrives when cultivated simply by itself; it requires to be combined with other grasses, to secure its continuance in the soil, and to obtain its produce in perfection. It thrives best when combined with the *Hordeum pratense,* (meadow barley); *Cynosurus cristatus,* (crested dog's-tail); and *Anthoxanthum odoratum,* (sweet-scented vernal-grass). It affects most a calcareous soil, and that which is dry. It grows naturally, however, in almost every kind of soil, from the lime-stone rock to the irrigated meadow: it is always present in the richest natural pastures. From the above details, its produce is not very great, nor its nutritive qualities considerable. The nutritive matter it affords from its leaves, (the properties of which are of more importance to be known than those of the culms, for a permanent pasture grass), contains proportionally more bitter extractive, than what is contained in the nutritive matters of the grasses with which it is more generally combined in natural pastures, and which have just now been mentioned. This latter circumstance is the chief claim


Avena flavescens.
Golden Oat-grass.

it has to a place in the composition of the produce of rich pasture land; but more particularly, if the land be elevated and without good shelter, this grass becomes more valuable, as it thrives better under such circumstances than most other grasses, and sheep eat it as readily as they do most others. The seed is very small and light; but it vegetates freely if sown in the autumn, or not too early in the spring. I have sown the seeds of this grass in almost every month of the year, and after making due allowance for the state of the weather, the third week in May, and the first week of September, were evidently the best.

It flowers in the first, and often in the second week of July, and ripens the seed in the beginning of August.

Holcus lanatus. Woolly Soft-grass.

Specific character: Root fibrous; panicle equally diffused; bisexual floret inferior, awnless; unisexual floret awned, the awn recurved and inclosed by the calyx.

Obs.—Practical Farmers often mistake this grass for the creeping-rooted soft-grass; I have therefore given a specimen of the latter in the next following page, for the convenience of comparison, otherwise it belongs to another division of the subject, that is, grasses natural to sandy soils. The male, or unisexual floret, contains one pistle; the germen, or rudiment of the future seed, is similar to that of the fertile or bisexual floret, but much smaller; it is always abortive.

Native of Britain. Perennial. E. Bot. 1169; Host. t. 2; Curt. Lond. fasc. 38; Wither. Arr.; Flo. Germ. i. p. 251.

Experiments.—About the middle of April, the produce from a clayey loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 7 oz. The produce per acre - - - - -			76230	0 =	4764	6	0
64 dr. of grass afford of nutritive matter -	2	1 per acre -	2679	15 =	167	7	15
At the time of flowering, the produce is,							
Grass, 28 oz. The produce per acre - - - -			304920	0 =	19057	8	0
64 dr. of grass afford of nutritive matter -	4	0	- -	19057	8 =	1191	1 8
The produce of the space, ditto - -	28	0					
80 dr. of grass weigh, when dry - -	26	0	- -	99099	0 =	6193	11 0
The produce of the space, ditto - -	145	$2\frac{2}{5}$					
The weight lost by the produce of one acre in drying - - - -				12863	13	0	
At the time the seed is ripe, the produce is,							
Grass, 28 oz. The produce per acre - - - -			304920	0 =	19057	8	0
80 dr. of grass weigh, when dry - -	16	0	- -	60984	0 =	3811	8 0
The produce of the space, ditto - -	89	$2\frac{2}{5}$					
The weight lost by the produce of one acre in drying - - - -				15246	0	0	
64 dr. of grass afford of nutritive matter -	2	3	- -	13102	0 =	818	14 0
The produce of the space, ditto - -	19	1					
The weight of nutritive matter which is lost by leaving the crop till the seed be ripe, exceeding one-third part of its value, is - - - - - -				372	3	8	

The proportional value, in which the first grass of the spring is inferior to that at the time of flowering, is as 16 to 9; and the grass of the flowering crop, exceeds that of the seed crop in the proportion of 16 to 11.

Holcus lanatus.

Woolly Soft-grass.

The produce of latter-math is,

		dr.	qr.		oz.			lbs.	
Grass, 10 oz. The produce per acre	-	-	-	-	108900	0	=	6806	1 0
64 dr. of grass afford of nutritive matter	-	1	2 per acre	-	2552	5	=	159	8 5

The grass of the latter-math is therefore of inferior value to that of the spring, to that at the time of flowering, and to that at the time the seed is ripe.

This is a very common grass, and grows on all soils, from the richest to the poorest. It attains to the greatest degree of luxuriance on light moist soils; particularly on those of a peaty nature. Cattle prefer almost any other grass to this; it is seen in pastures with full grown perfect leaves, while the grasses that surround it are cropped to the roots.

The numerous downy hairs which cover the surface of the whole plant, render the hay that is made of it soft and spongy, and in this state it is disliked by cattle, particularly by horses. Sir Humphry Davy has shewn, that its nutritive matter consists entirely of mucilage and sugar; and that the nutritive matters of the grasses most liked by cattle, have either a sub-acid or saline taste; and observes, that the taste of the nutritive matter of the *Holcus lanatus*, is similar to that of gum Arabic; and this grass might probably be made more palatable to cattle by being sprinkled over with salt. This may be done at so little expence and trouble at the time the hay is carried, that it cannot be too earnestly recommended to the notice of those gentlemen who may have much of this grass in their meadows or pastures. The late Duke of Bedford made trial of this grass on a large scale: the results proved that it was a very inferior grass for pasture, or for hay. Its merits consist in being productive, and easy of cultivation. But it is disliked by cattle: is not an early grass; and when once in possession of the soil, can hardly be again rooted out. There being so many grasses superior to this in every respect, it cannot support any claim to a place in the composition of the best permanent pastures. It produces a profusion of seed, which being light, is easily dispersed by the winds; and though a late flowering grass, the seed ripens sooner than that of most others, and before hay-harvest begins, is generally perfected. The question is, therefore, how to get free of it: hard stocking, and never suffering it to run to seed, will at least prevent it from spreading farther. But ploughing up the pasture, and taking not less than a five years' course of crops, and then returning the land to other grasses, will be found the best remedy. Flowers and ripens the seed in July.

Holcus mollis. Creeping Soft-grass, Couch-grass.

Specific character: Root creeping, panicle regular, bisexual floret inferior, awnless: unisexual or male floret awned, awn incurved, protruding out of the calyx.

Obs.—The creeping root of this species of soft grass, at once determines it to be distinct from the *Holcus lanatus.* The leaves are also narrower, and more soft than those of the *Holcus lanatus,* and grow more distinct from each other; on the contrary, those of the *H. lanatus* are in dense tufts. The awn in the *lanatus* is hid in the calyx; but in the *mollis* it protrudes out of the calyx; it is also twisted and knee-bent, like that of an *Avena.* The panicle of the *lanatus* is generally of a reddish purple colour, tinged with green, or, when

Holcus mollis.

Creeping Soft-grass.

growing under the shade of trees, of a whitish green colour. The panicle of the *H. mollis* is always of a pale whitish green colour.

Perennial. Native of Britain. E. Bot. 1170; Host. t. 3; Curt. Lond. fasc. 54; Wither. Arr.; Hort. Kew.

Experiments.—At the time of flowering, the produce from a sandy soil, is,

	dr.	qr.	oz.		lbs.		
Grass, 50 oz. The produce per acre - - - - - -			544500	0 =	34031	4	0
80 dr. of grass weigh, when dry - -	32	0	217800	0 =	13612	8	0
The produce of the space, ditto - -	320	0					
The weight lost by the produce of one acre in drying - - - - - -			20418	12	0		
64 dr. of grass afford of nutritive matter -	4	2	38285	2 =	2392	13	2
The produce of the space, ditto - -	56	1					
At the time the seed is ripe, the produce is,							
Grass, 31 oz. The produce per acre - - - -			337590	0 =	21099	6	0
80 dr. of grass weigh, when dry -	32	0	135036	0 =	8439	12	0
The produce of the space, ditto - -	198	$1\frac{3}{5}$					
The weight lost by the produce of one acre in drying - - - -			12659	10	0		
64 dr. of grass afford of nutritive matter -	3	2	18461	15 =	1153	13	15
The produce of the space, ditto - -	27	$0\frac{2}{5}$					
The weight of nutritive matter which is lost by leaving the crop till the seed be ripe, exceeding one-half of its value, is - - - - - - - -					1238	15	3

The proportional value in which the grass of the flowering crop exceeds that of the seed crop, is as 9 to 7.

64 dr. of the roots afford of nutritive matter 5 dr. 2 qr. The nutritive powers of the roots are therefore superior to that of the grass of the flowering crop, as 11 to 9, and also superior to the grass of the seeding crop, as 11 to 7.

The above details prove this grass to have merits which, when compared with those of other species, rank it as one of the superior grasses. But then it produces little herbage in the spring, and the latter-math is next to nothing. It is also a very late grass, and whatever merit it may possess with regard to a crop, at the time of flowering, it can only be taken into the account in relation to the soil which naturally produces it, which is a light barren sandy soil. If we therefore compare its produce on such soils with that of other grasses, it will prove superior; but there it must remain, for on all other soils it will be found inferior to most other grasses. The roots, when once in possession of the soil, can hardly be again expelled without great labour and expence. It is the true couch-grass of light sandy soils; I have found roots five feet in length, the growth of a few months only. The roots contain a very considerable quantity of nutritive matter, which has the flavour of new-made meal. Pigs are very fond of the roots, and dig them up with eagerness. How far it might be advantageous to cultivate this grass on naked sands, for the sake of the roots, I shall not presume to determine; but the strong nutritive powers they possess, and the little expence that would attend their culture, warrant the recommendation of trial, to those who may have such barren sands in their possession. The herbage is apparently more disliked by cattle than that of the *Holcus lanatus;* it is extremely soft, dry, and tasteless. The best mode of banishing this impoverishing and most troublesome

weed from light arable lands that are infested with it, is to collect the roots with the fork after the plough; and when thus in some measure lessened, to apply yearly, sufficient dressings of clay, perhaps fifty load per acre, till the texture of the soil is changed to a sandy loam: this grass will then be easily overcome, and the fertility of the soil permanently increased.

Holcus odoratus, (repens). Sweet-scented Soft-grass.

Specific character: Panicle mostly flowering on one side; fruit-stalks smooth; bisexual floret awnless; male, or unisexual floret, furnished with a short awn. *Holcus repens,* Host. vol. iii. p. 3, t. 3; *Holcus odoratus,* Flo. Dan. t. 963; *Holcus borealis,* Flo. Germ. p. 252.

Obs.—Botanists have made two species here, which I include in one, as I can perceive no difference in their structure, habits, or agricultural merits, sufficient to separate them. The *nectary* is the only part wherein these plants vary from each other in a sensible degree, but what may be accounted for from the circumstances of soil and situation. If they are to remain distinct species, they are artificial in no ordinary degree.

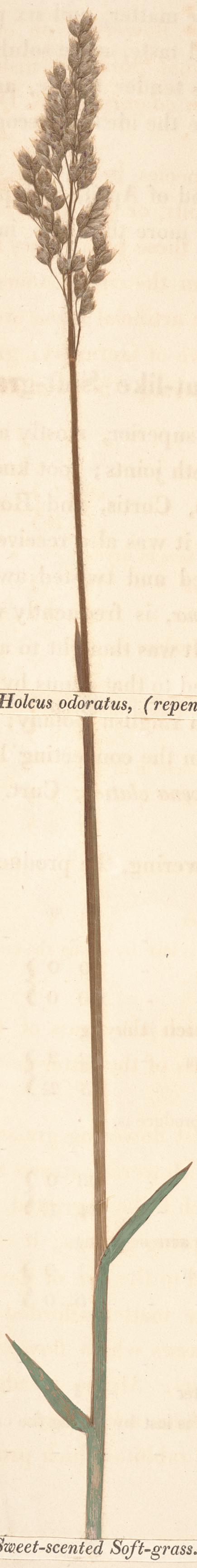
Root creeping. Perennial. Native of Germany; grows in moist meadows.

Experiments.—At the time of flowering, the produce is,

	dr.	qr.	oz.		lbs.		
Grass, 14 oz. The produce per acre - - - -			152460	0 =	9528	12	0
80 dr. of grass weigh, when dry - -	20	2	- -	39067	14 =	2441	11 14
The produce of the space, ditto - -	57	1⅗					
The weight lost by the produce of one acre in drying - - - -				7087	0	2	
64 dr. of grass afford of nutritive matter -	4	1	- -	10124	4 =	632	12 4
The produce of the space, ditto - -	14	3½					
At the time the seed is ripe, the produce is,							
Grass, 40 oz. The produce per acre - - - -			435600	0 =	27225	0	0
80 dr. of grass weigh, when dry - -	28	0	- -	152460	0 =	9528	12 0
The produce of the space, ditto - -	224	0					
The weight lost by the produce of one acre in drying - - - - - -				17696	4	0	
64 dr. of grass afford of nutritive matter -	5	1	- -	35732	13 =	2233	4 13
The produce of the space, ditto - -	52	2					
The produce of latter-math is,							
Grass, 25 oz. The produce per acre - - - - - -			272250	0 =	17015	10	0
64 dr. of grass afford of nutritive matter -	4	1	- -	18079	1 =	1129	15 1
The weight of nutritive matter which is lost by taking the crop at the time of flowering, exceeding one-half its value, is - - - - - - - - - -				1600	8	9	

The proportional value in which the grass of the seed crop exceeds that at the time of flowering, is as 21 to 17. The grass of the latter-math, and the grass at the time of flowering, are of equal proportional value.

Though this is one of the earliest flowering grasses, it is tender, and the spring produce of herbage is very inconsiderable, the flowering straws rising up in a manner destitute of leaves. This deficiency of produce is much to be regretted, as the nutritive qualities of the grass are greater than in most of the early spring grasses: it sends forth but a few flower straws, which are of a slender structure, compared to the size of the leaves. This accounts, in a great measure, for the equal quantities of nutritive matter afforded by the grass at the time of flowering, and that of the latter-math. The grasses which flower about the same time as this species, are, blue moor-grass, *(Sesleria cærulea);* Alpine meadow-grass, *(Poa alpina);* and the sweet-scented vernal-grass, *(Anthoxanthum odoratum).* In no instance, that I have observed, was this grass eaten by the hares and rabbits which preyed upon many of the other grasses. Sir



Holcus odoratus, (repens).

Sweet-scented Soft-grass.

H. Davy has shewn, that 82 parts of the nutritive matter of this grass, consist of 72 parts mucilage or starch, four parts saccharine matter, and six parts of bitter extractive matter, and a peculiar substance which has an acrid taste, more soluble in alcohol than in water. The powerful creeping roots of this grass, its tender nature, and the great deficiency of foliage in the spring, are demerits which discourage the idea of recommending it farther to the notice of the Agriculturist.

It comes into flower about the end of April, and perfects the seed about the third week of June. It perfects few seeds, seldom more than two in a panicle. But few grasses propagate more quickly by the roots.

Holcus avenaceus. Tall Oat-like Soft-grass.

Specific character: Bisexual floret superior, mostly awnless; male, or unisexual floret, with a jointed awn; culm with smooth joints; root knobbed, or bulbous.

Obs.—In the works of Linnæus, Curtis, and Host, this grass is found under the name of *Avena elatior;* under this name it was also received in the first account of the results of these experiments. The jointed and twisted awn, from the back of the blossom, which caused it to rank with the *avenæ,* is frequently wanting altogether, which is evident in the next following specimen. It was thought to agree better with the *holci* in structure; it has in consequence been referred to that genus by Scopoli, in the Flora Carniolica; and by Dr. Smith, in the Flo. Brit. and English Botany; indeed, it appears to belong to neither of these justly, but serves to form the connecting link between the *avenæ, holci,* and *airæ.* Eng. Bot. 813; Host. t. 49, *Avena elatior;* Curt. Lond. *Avena elatior.*

Native of Britain. Perennial.

Experiments.—At the time of flowering, the produce from a clayey loam, is,

	dr.	qr.		oz.		lbs.		
Grass, 25 oz. The produce per acre - - - -				272250	0 =	17015	10	0
80 dr. of grass weigh, when dry - -	30	0						
The produce of the space, ditto - -	150	0	- -	102081	0 =	6380	10	0
The weight lost by the produce of one acre in drying - - - -				11635	0			
64 dr. of grass afford of nutritive matter -	2	2						
The produce of the space, ditto - -	15	$2\frac{2}{4}$	- -	10634	12 =	664	10	0
At the time the seed is ripe, the produce is,								
Grass, 24 oz. The produce per acre - - - -				261360	0 =	16335	0	0
80 dr. of grass weigh, when dry - -	28	0						
The produce of the space, ditto - -	134	$1\frac{3}{5}$	- -	91476	0 =	5717	3	0
The weight lost by the produce of one acre in drying - - - -				10617	13	0		
64 dr. of grass afford of nutritive matter -	1	0						
The produce of the space, ditto - - -	6	0	- -	4083	12 =	255	3	12
The produce of latter-math is,								
Grass, 20 oz. The produce per acre - - - - -				217800	0 =	13612	8	0
64 dr. of grass afford of nutritive matter -	1	1	- - -	4253	14 =	265	13	14
The weight of nutritive matter which is lost by leaving the crop till the seed be ripe, exceeding one-half of its value, is - - - - - - - -				409	6	4		

Holcus avenaceus.

Tall Oat-like Soft-grass.

The proportional value in which the grass at the time of flowering exceeds that at the time the seed is ripe, is as 5 to 2, and is superior to the grass of the latter-math, in the proportion of 2 to 1.

This grass sends forth flowering culms during the whole of the season, and the latter-math produce, consequently, contains nearly an equal quantity of culms with the flowering crop. It is subject to the disease termed rust, but it does not make its appearance till after the period of flowering; it affects the whole plant, and at the time the seed is ripe, the culms, and many of the root leaves are withered and dry, from its baneful effects. This clearly explains the cause of the latter-math being superior to the crop at the time the seed is ripe; and points out the propriety of taking the crop as soon as the grass is in flower.

When cultivated on a heath soil, the subsoil being a strong clay, the nutritive powers of the grass were greater. 64 dr. of this grass afforded 4 dr. of nutritive matter, which shews the grass, in this instance, to be of greater value than that from a clayey loam, in the proportion of 8 to 5. But the weight of grass produced on the clayey loam, was superior to that on the heath soil, in the proportion of 25 to 8. To account for this, we have only to observe, that the produce of the heath soil consisted chiefly of culms, while that of the clayey loam consisted more of leaves. This grass is eaten by all sorts of cattle. Its produce is very great, but the nutritive qualities of the grass are inferior to many other grasses. It pushes rapidly after being cropped; and though later in flowering than many other species, produces an early and plentiful supply of herbage in the spring. These properties would entitle it to rank high as a grass adapted for the alternate husbandry, but its nutritive matter contains too large a proportion of bitter extractive, and saline matters, to warrant its cultivation, without a considerable admixture of different grasses; and the same objection extends to its culture for permanent pasture. It is always present in the composition of the best natural pastures; and, as before mentioned, eaten in common with other grasses. It does not, however, constitute a large proportion of the herbage, but rather the least of any of the more valuable grasses that have been mentioned.

Its produce on different soils, from the time it was sown, April 23, 1813, till the period it was cut, July 10, 1813, being less than three months, was as follows:

Rich clayey loam, grass, 25 oz. 64 dr. of which afforded of nutritive matter - -	73 grains.
Clayey loam, grass, 23 oz. 64 dr. of which afforded of nutritive matter - - -	84
Rich black siliceous sandy soil, grass, 13 oz. 64 dr. of which afforded of nutritive matter -	89
Poor siliceous sandy soil, grass, 10 oz. 64 dr. of which afforded of nutritive matter -	80
Heath soil, grass, 8 oz. 64 dr. of which afforded of nutritive matter - - - -	83

The difference in the quantity of nutritive matter afforded by the produce of these different soils, seemed solely to arise from the proportion of culms contained in the different crops; the produce of the rich black siliceous soil, for instance, contained by far the greatest proportion of flowering culms, and that of the rich clayey loam, the least.

From the above details it appears, that this grass should have a place in the composition of the best natural, or permanent pastures, though its proportion, as a constituent, should be much limited. Flowers towards the end of June, and ripens the seed about the second week of July.

Holcus avenaceus, var. *Muticus*. Awnless tall Oat-like Soft-grass.

Var.—Flowers without awns.

Obs.—This variety is smaller in every respect than the preceding; leaves very short; root slightly bulbous; panicle much contracted; glumes pencilled at the apex with purple. Flowers a week later than the awned variety; in all other respects it is the same.

Native of Scotland. Curt.

Experiments.—At the time of flowering, the produce from a rich clayey loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 18 oz. The produce per acre - - - -			196020	0 =	12251	4	0
80 dr. of grass weigh when dry - -	28	0	68607	0 =	4287	15	0
The produce of the space, ditto - -	100	$3\frac{1}{5}$					
The weight lost by the produce of one acre in drying - - - -			7963	5	0		
64 dr. of grass afford of nutritive matter -	3	2	10719	13 =	669	15	13
The produce of the space, ditto - -	15	3					
The produce of latter-math is,							
Grass, 5 oz. The produce per acre - - - -			54450	0 =	3403	2	0
64 dr. of grass afford of nutritive matter -	1	0	850	12 =	53	2	12

This variety is much later, in respect of producing herbage in the spring, and in coming into flower, than the awned variety. It seldom perfects any good seed. It appears to be much inferior in point of produce, as the following comparison will manifest:

		lbs.
Holcus avenaceus, var. *aristatus*, or awned variety, affords of nutritive matter from the produce of one acre, at the time of flowering - - - - - -	664	929
The produce of latter-math affords of nutritive matter - - - -	265	
The *Holcus avenaceus*, var. *muticus*, or awnless variety, as above, affords of nutritive matter from the produce of one acre, at the time of flowering - -	669	722
The produce of latter-math, ditto - - - - - - - - -	53	
The weight of nutritive matter in which the produce of one acre of the awned variety of the tall oat-like soft-grass exceeds that of the awnless variety, is - -		207

The latter-math produce is very inconsiderable, and but little nutritive. The nutritive matter contains a little more saccharine matter, in proportion to the other ingredients, than what is contained in the nutritive matter of the awned variety. Hares give a decided preference to the awnless variety. If this grass had merits which entitled it to a place among the superior grasses, it could not be cultivated with advantage, on account of its deficiency of seed, and impatience of being transplanted by parting the roots. It can only be offered, therefore, as a botanical curiosity.

It flowers a week later than the awned variety.

Holcus avenaceus, var. *muticus*.

Awnless tall Oat-like Soft-grass.

Bromus arvensis. Field Brome-grass.

Specific character: Panicle almost upright; spikets linear spear-shaped, compressed, naked; flowers imbricated; awn straight, about the length of the husks; leaves villous.

Obs.—Culms from two to three feet in height; more or less declining at the base, afterwards erect, roundish, striated, smooth. Panicle generally six inches in length, many-flowered; main branch, or stem of the panicle, striated, smooth below, above flexuose. Spikets greenish on the upper side, and of a purplish brown on the other. This species resembles, in some measure, the *Bromus multiflorus;* but the spikets being much more linear, and the brown or purple tinge on the under side of the spikets, readily distinguish them.

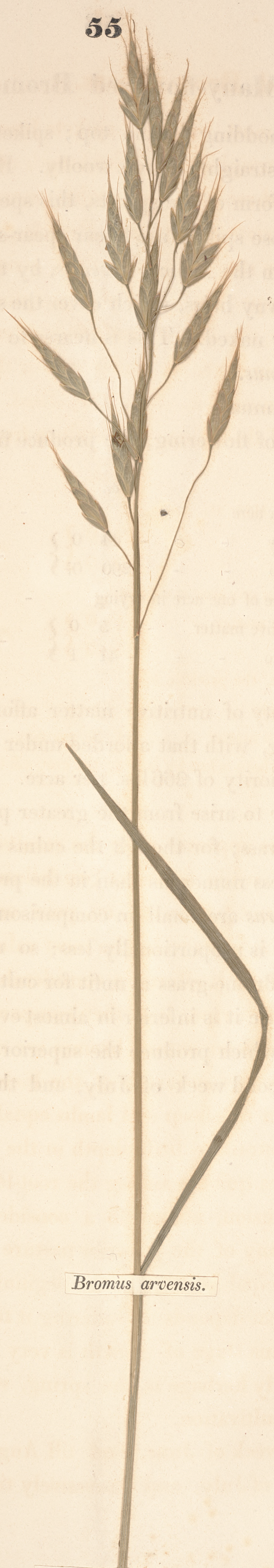
Native of Britain. Root annual. E. Bot. 920; Host. t. 14; Flo. Ger.

Experiments.—At the time of flowering, the produce from a sandy loam, is,

	dr.	qr.		oz.		lbs.		
Grass, 35 oz. The produce per acre, is, -			- -	381150	0 =	23821	14	0
80 dr. of grass weigh, when dry - -	40	0	- -	190575	0 =	11910	15	0
The produce of the space, ditto - -	280	0						
The weight lost by the produce of one acre in drying - - - - - - -						11910	15	0
64 dr. of grass afford of nutritive matter -	4	0	- -	23821	14 =	1488	13	14
The produce of the space, ditto - - -	35	0						
At the time the seed is ripe, the produce is,								
Grass, 10 oz. the produce per acre - - - - -				108900	0 =	6806	4	0
64 dr. of grass afford of nutritive matter -	1	2	per acre -	2552	5 =	147	0	0
The weight of nutritive matter which is lost by leaving the crop till the seed be ripe, exceeding ten times its value, is - - - - - - - -						1341	13	14

This species of Brome-grass appears, from the results of all my observations, to be confined to rich pastures and meadows, while the next two following species, *Bromus multiflorus,* and *Bromus mollis,* are chiefly found to prevail on poor or exhausted grass lands. They are all strictly annual. This species appears to be the most valuable of the three. When this grass is mown at the time of flowering, it affords a considerable weight of nutritive hay; but when left uncut till the time the seed is ripe, it is then comparatively of no value, which is manifest from the above details. All these annual bromes are considered bad grasses by the Farmer. This much, however, may be said in favour of the Field Brome-grass, that it affords an early bite in the spring, and is eaten by sheep and lambs equally with other grasses. It exhausts the soil but little; the roots penetrate to little depth in the earth. The seed falls from the husks as soon as ripe, and vegetates quickly among the root-leaves of the perennial grasses, and before autumn draws to a conclusion, attains to a considerable size. This grass withstands the effects of frost better than many of the superior pasture grasses: hence it is among the early grasses, which afford the principal herbage in the beginning of spring. Being strictly an annual plant, its existence another year depends on suffering it to perfect its seed, and, as before stated, the value of its produce at this stage of growth is very little; so that its merits are reduced to this one, the produce of early herbage in the spring, which will appear insufficient to recommend it for the purposes of cultivation.

It flowers in the second week of June, and till August it sends up flowering culms. The seed is ripe in the first week of July, and successively till the middle of September.



Bromus arvensis.

Field Brome-grass.

Bromus multiflorus. Many-flowered Brome-grass.

Specific character: Panicle nodding at the top; spikets spear-shaped, compressed, naked; flowers imbricated; awn straight; leaves woolly. Host. t. 11.

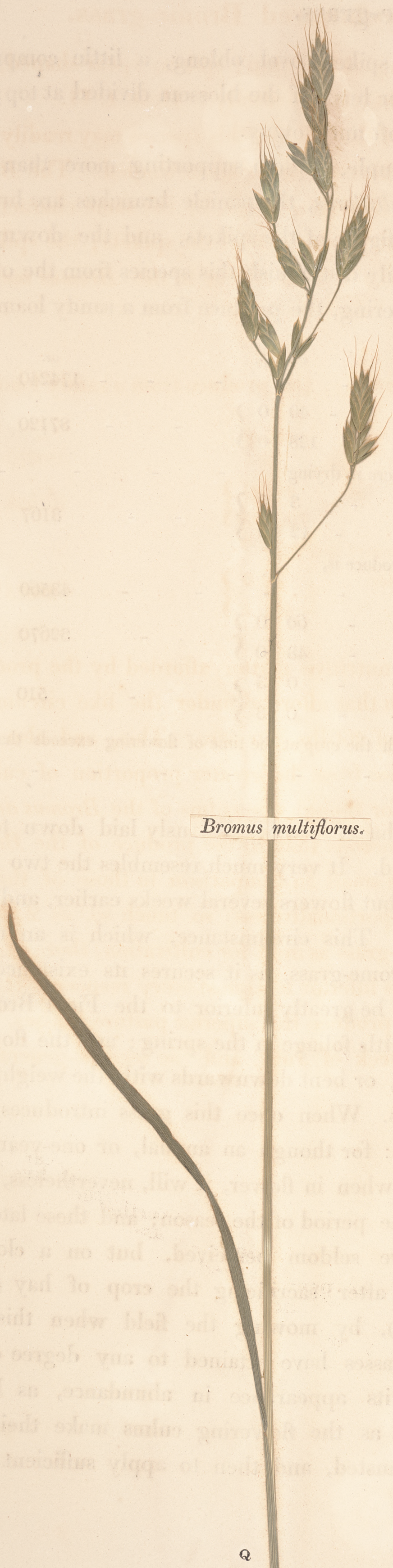
Obs.—By attending to the form of the spikets, this species may readily be distinguished from the *Bromus arvensis,* whose spikets are linear spear-shaped. The *Bromus mollis* may likewise be distinguished from the *Bromus arvensis,* by the same character; and from the *Bromus multiflorus* by its downy hairs, which cover the spikets; the spikets of the *B. arvensis,* and *B. multiflorus,* being naked. This is nearer to the *Bromus multiflorus* of the E. Bot. than to the *Bromus secalinus.*

Native of Britain. Root annual.

Experiments.—At the time of flowering, the produce from a sandy loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 33 oz. The produce per acre	-	-	359370	0 =	22460	10	0
80 dr. of grass weigh, when dry - - -	44	0	- -	197653	8 =	12353	5 8
The produce of the space, ditto - -	290	$0\frac{2}{5}$					
The weight lost by the produce of one acre in drying			- - - -	10107	4 8		
64 dr. of grass afford of nutritive matter -	5	0	- -	28075	12 =	1754	11 12
The produce of the space, ditto - - -	41	1					

On comparing the quantity of nutritive matter afforded by the produce of one acre of this grass at the time of flowering, with that afforded under the like circumstances by the *Bromus arvensis,* it manifests a superiority of 266lbs. per acre. This, and also the superior nutritive qualities of the grass, appear to arise from the greater proportion of culms in the produce of the Many-flowered Brome-grass; for though the culms of the *Bromus arvensis* grow to a much larger size, they are much less numerous than in the produce of the *Bromus multiflorus.* The leaves of the *Bromus multiflorus* are small in comparison to those of the *Bromus arvensis,* and the spring produce of foliage is proportionally less; so much so, as 2 to 1. If there was any doubt of rejecting the Field Brome-grass as unfit for cultivation, there can be none for the Many-flowered Brome-grass, because it is inferior in almost every respect. It is natural to soils of a less rich nature, than those which produce the superior pasture grasses, and the *Bromus arvensis.* It flowers about the second week of July, and the seed is generally ripe in three weeks afterwards.



Bromus multiflorus.

Q

Many-flowered Brome-grass.

Bromus mollis. **Soft Brome-grass.**

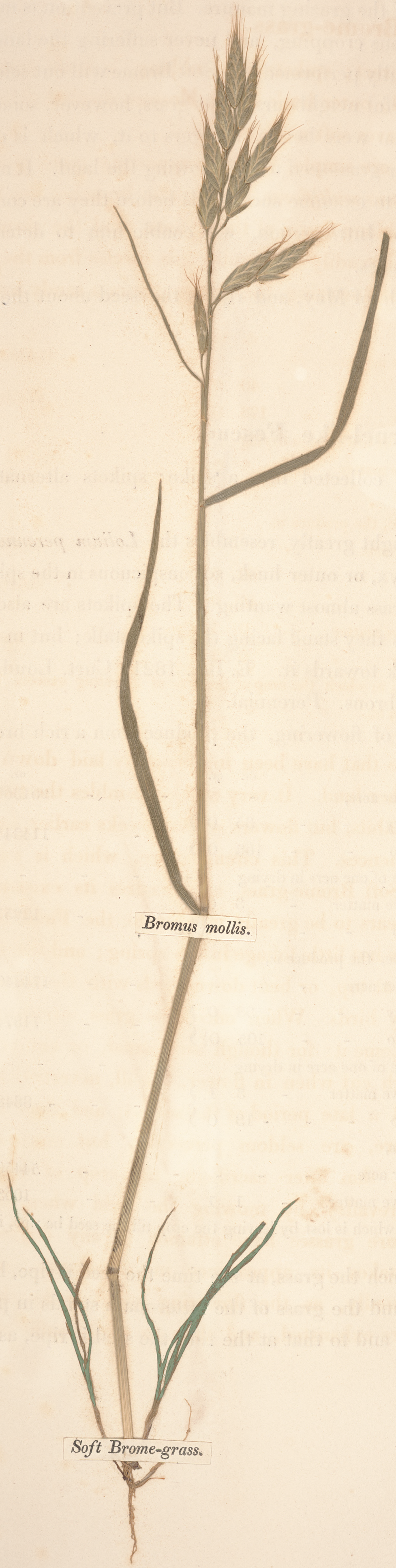
Specific character: Panicle erect; spikets oval oblong, a little compressed, covered with down; flowers imbricated; outer husk of the blossom divided at top; awn straight, about the length of the husk; leaves soft and downy.

Obs.—The panicle branches are simple, seldom supporting more than one spiket. In the *Bromus arvensis* and *Bromus multiflorus*, the panicle branches are branched, and some of them simple. The oval oblong figure of the spikets, and the downy hairs which cover them, are characters which readily distinguish this species from the others.

Experiments.—At the time of flowering, the produce from a sandy loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 16 oz. The produce per acre is - - - - -			174240	0 =	10890	0	0
80 dr. of grass weigh, when dry - -	40	0	- - 87120	0 =	5445	0	0
The produce of the space, ditto - -	128	0					
The weight lost by the produce of one acre in drying - - - -			5445	0	5445	0	0
64 dr. of grass afford of nutritive matter -	3	0	- - 8167	8 =	510	7	8
The produce of the space, ditto - -	12	0					
At the time the seed is ripe, the produce is,							
Grass, 4 oz. The produce per acre - - - -			43560	0 =	2722	8	0
80 dr. of grass weigh when dry - -	60	0	- 32670	0 =	2041	14	0
The produce of the space, ditto - -	48	0					
64 dr. of grass afford of nutritive matter -	0	3	- 510	7 =	31	14	7
The produce of the space, ditto - -	0	3					
The weight of nutritive matter, in which the crop at the time of flowering exceeds that at the time the seed is ripe, is, - - - - - -					478	9	1

On all poor exhausted soils that have been injudiciously laid down to grass, this species is more common than on any other land. It very much resembles the two last-mentioned species of *bromus* in appearance and habits, but flowers several weeks earlier, and the seed is ripe generally before hay-harvest commences. This circumstance, which is an unfortunate one to the Farmer, is favourable to the Soft Brome-grass, as it secures its existence for another season. From the above details it appears to be greatly inferior to the Field Brome-grass, and Many-flowered Brome. It produces but little foliage in the spring; and the flowering culms are soon formed, and become nodding at top, or bent downwards with the weight of the seed, which is large, and much relished by birds. When once this grass introduces itself into a field, it is a very difficult task to overcome it: for though an annual, or one-year lived plant, like the other two bromes, and though cut when in flower, it will, nevertheless, continue to send up fresh culms from the root till a late period of the season; and these late or secondary culms being of a very low stature, are seldom perceived, but on a close inspection of the herbage. Thus it happens, that after sacrificing the crop of hay (but which indeed is never great if this grass prevails), by mowing the field when this grass is in flower, and before the other pasture grasses have attained to any degree of maturity, the Soft Brome-grass next season makes its appearance in abundance, as before. One remedy is, therefore, to mow repeatedly, as the flowering culms make their appearance, till the roots of the annual grass are exhausted, and then to apply sufficient top-dressings to com-


Bromus mollis.
Soft Brome-grass.

pensate the soil for the want of the grazing manure. But prevention is most to be recommended, and that is effected by judicious cropping, and never suffering the land to become too poor or exhausted: when this is faithfully performed, the Soft Brome will but seldom appear, or will soon be overcome by its more powerful neighbours. This grass, however, sometimes makes its appearance on a sudden in lands that were before strangers to it, which is caused by its seed being mixed with that of the grain or grass-seed used in sowing the land. It may therefore be worthy the notice of the Agriculturist to examine such seeds before they are committed to the soil. The specimens of seeds given in the Introduction, will enable him to detect the seed of the Soft Brome, and other inferior grasses.

It flowers about the middle of May, and ripens the seed about the first or second week of June.

Festuca loliacea. Darnel-like Fescue.

Specific character: Flowers collected into a spike; spikets alternate, sitting, compressed, awnless.

Obs.—This grass at first sight greatly resembles the *Lolium perenne*, (rye-grass); but on a closer inspection, the calyx, or outer husk, so conspicuous in the spikets of the rye-grass, is in the spikets of this grass almost wanting. The spikets are also arranged in a different manner: in the rye-grass they stand facing the spike-stalk; but in the Darnel-like Fescue, they stand with their back towards it. E. Bot. 1821; Curt. Lond.; Huds.

Native of Britain. Root fibrous. Perennial.

Experiments.—At the time of flowering, the produce from a rich brown loam, is,

	dr.	qr.		oz.		lbs.		
Grass, 24 oz. The produce per acre,	-		-	-	261360	0 =	16335	0 0
80 dr. of grass weigh, when dry - -	35	0						
The produce of the space, ditto - -	168	0	-	-	114345	0 =	7146	9 0
The weight lost by the produce of one acre in drying			-	-	-	-	9188	7 0
64 dr. of grass afford of nutritive matter -	3	0						
The produce of the space, ditto - -	18	0	-	-	12251	4 =	765	11 0
At the time the seed is ripe, the produce is,								
Grass, 16 oz. The produce per acre - - - - - -					174240	0 =	10890	0 0
80 dr. of grass weigh, when dry - -	33	0						
The produce of the space, ditto - -	105	$0\frac{3}{4}$	-	-	71874	0 =	4492	2 0
The weight lost by the produce of one acre in drying			-	-	-	-	6397	14 0
64 dr. of grass afford of nutritive matter -	3	1						
The produce of the space, ditto - - -	13	0	-	-	- 8848	2 =	553	2 0
The latter-math produce is,								
Grass, 5 oz. The produce per acre - - - - - -					54450	0 =	3403	2 0
64 dr. of grass afford of nutritive matter -	1	1	-	-	1063	7 =	66	7 7
The weight of nutritive matter which is lost by leaving the crop till the seed be ripe, is -							212	9 0

The proportional value which the grass, at the time the seed is ripe, bears to that at the time of flowering, is as 13 to 12; and the grass of the latter-math stands in proportion to that at the time of flowering, as 12 to 5, and to that at the time the seed is ripe, as 13 to 5.

Festuca loliacea.

Darnel-like Fescue.

This species of fescue is very much like the rye-grass in appearance; it likewise affects the same kind of soil as Rye-grass. Some Botanists have supposed it to be a hybrid, the joint produce of the *Lolium perenne*, (rye-grass), and *Festuca fluitans*, (flote fescue); but the time when the rye-grass, *(Lolium perenne)*, comes into flower, is nearer to that in which the Meadow Fescue *(Festuca pratensis)* is in flower than the Flote Fescue; the soil and habits of the two former grasses are likewise more similar.

From the above details, it appears that this species of fescue is much superior to Rye-grass in point of produce. The following comparison of the quantity of nutritive matter afforded by the produce of one acre, will shew the degree of superiority.

Lolium perenne, rye-grass, affords,

	lbs.			lbs.		
Of nutritive matter, from the produce of one acre, at the time of flowering	305	11	15	1002	5	2
Of nutritive matter, from the produce of one acre, at the time the seed is ripe	643	6	7			
Of nutritive matter, from the produce of latter-math - - - -	53	2	12			

Festuca loliacea, darnel-like fescue, affords,

Of nutritive matter, from the produce of one acre, of the flowering, seed, and latter-math crops, as above - - - - - - - - - - - -	1385	4	7
The weight of nutritive matter, in which one acre of the darnel-like fescue exceeds that of the *Lolium perenne*, or rye-grass, is - - - - - - - -	382	15	5

Or in the proportion nearly of 4 to 3.

This grass likewise springs earlier than the Rye-grass, and improves by age, which is not the case with Rye-grass, as it decreases in value, with respect to produce and early growth, after the fourth year of its being sown, while the Darnel-like Fescue improves in these properties after that period of growth. Unfortunately, however, this grass does not perfect its seed, the flowers generally proving abortive, which renders its cultivation, or rather, propagation, inconvenient and expensive. By parting the roots, and transplanting them, it might readily be propagated; but its merits hardly warrant the practice.

It flowers in the last week of June, and ripens the seed, (if any), in the third week of July.

Festuca glabra. Smooth Fescue.

Specific character: Panicle branched, upright, compact; spikets spear-shaped, 4-6 flowered, smooth, awned. Root fibrous.

Obs.—This is nearly allied to the *Festuca duriuscula;* it differs in having the awns longer, panicle branches, and spikets smoother; spikets shining, root and leaves much longer. This is, according to Dr. Smith, a variety of the *Festuca rubra;* but the roots are fibrous and not creeping, which characterises the varieties of the *Festuca rubra.* To the Agriculturist the distinction, creeping root, is sufficient to guide him in this instance, as the varieties of the creeping-rooted species are all to be rejected as unfit for cultivation; and among the fibrous-rooted varieties of the *Festuca duriuscula,* there is not so great a difference in their

Festuca glabra.

Smooth Fescue.

comparative value, as to render the adoption of one for the other of so much importance as in many other instances, where the distinctions are equally minute.

Native of Britain. Perennial.

Experiments.—At the time of flowering, the produce from a sandy loam with manure, is,

	dr.	qr.		oz.		lbs.		
Grass, 21 oz. The produce per acre				228690	0 =	14293	2	0
80 dr. of grass weigh when dry	32	0		91476	0 =	5717	4	0
The produce of the space, ditto	134	$1\frac{3}{5}$						
The weight lost by the produce of one acre in drying						8576	14	0
64 dr. of grass afford of nutritive matter	2	0		7146	9 =	446	10	9
The produce of the space, ditto	10	2						
At the time the seed is ripe, the produce is,								
Grass, 14 oz. The produce per acre				152460	0 =	9528	12	0
80 dr. of grass weigh when dry	32	0		60984	0 =	3811	8	0
The produce of the space, ditto	89	$2\frac{2}{5}$						
The weight lost by the produce of one acre in drying						5717	4	0
64 dr. of grass afford of nutritive matter	1	1		2977	0 =	186	1	0
The produce of the space, ditto	4	$1\frac{1}{2}$						

The proportional value in which the grass, at the time of flowering, exceeds that at the time the seed is ripe, is as 8 to 5.

The produce of latter-math is,

Grass, 9 oz. The produce per acre			98010	0 =	6125	10	0
64 dr. of grass afford of nutritive matter	0	2	765	11 =	47	13	11

The proportional value, in which the grass at the time of flowering exceeds that of the latter-math, is as 4 to 1; and the grass, at the time the seed is ripe, exceeds that of the latter-math in the proportion of 5 to 2.

From the above details, which shew the produce and nutritive qualities of this grass, it appears to be inferior to the *Festuca duriuscula*, which will be manifest on a comparison of the former details respecting the *Festuca duriuscula*, with the above. In regard to early produce, however, this grass is superior. The herbage is uncommonly fine and succulent. But these merits appear hardly sufficient to compensate for the deficiency of produce. If its merits be compared with those of some of the early grasses, the *Anthoxanthum odoratum*, for instance, it will be found superior.

	lbs. per acre.	
Festuca glabra affords of nutritive matter,		
From the crop at the time of flowering	446	632
At the time the seed is ripe	186	
Anthoxanthum odoratum affords of nutritive matter,		
At the time of flowering	122	433
At the time the seed is ripe	311	
The weight of nutritive matter afforded by one acre of the *Festuca glabra*, exceeding that of the *Anthoxanthum odoratum* in the proportion nearly of 3 to 2, is		199

Though this grass cannot be recommended in preference to the *Festuca duriuscula*, yet it is evident from the above details, that among the fine-leaved fescues, it is the best substitute for that species where it is wanting. It is not so common as the *Festuca duriuscula*, being more confined to the moist spots of the pastures, though occasionally found also on the drier places, in company with it. Flowers in the second week of June, and ripens the seed in the second week of July.

Poa nemoralis. Wood Meadow-grass.

Specific character: Panicle flowering a little on one side, diffuse; spikets spear-shaped, mostly 3-flowered.

Obs.—The sheath-scale is very short, and truncated; straw rather compressed than otherwise, vagina smooth, root stoloniferous. Hardly any grass varies more than this one, in the number of florets contained in the calyx. In its natural place of growth, in woods under the shade of trees, it contains only three florets, and, when long cultivated, in exposed situations, the calyx is 4 and 5-flowered. The next following grass, though a distinct species, resembles this in several of its agricultural merits. E. Bot. 1265; Host. t. 71; Flo. Dant. t. 749; Flo. Ger. 301.

Root fibrous. Perennial.

Experiments.—At the time of flowering, the produce from a brown loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 13 oz. 8 dr. The produce per acre - - - -			147015	0 =	9188	7	0
80 dr. of grass weigh, when dry - -	34	0	- - 62481	6 =	3905	1	6
The produce of the space, ditto - -	91	$3\frac{1}{5}$					
The weight lost by the produce of one acre in drying - - - - - -			5283		5	10	
64 dr. of grass afford of nutritive matter -	4	0	- - 9188	7 =	574	4	7
The produce of the space, ditto - -	13	2					
At the time the seed is ripe, the produce is,							
Grass, 7 oz. The produce per acre - - - - - -			76230	0 =	4764	6	0
80 dr. of grass weigh, when dry - -	32	0	- - 30492	0 =	1905	12	0
The produce of the space, ditto - -	44	$3\frac{6}{80}$					
The weight lost by the produce of one acre in drying - - - -			2858		10	0	
64 dr. of grass afford of nutritive matter -	3	1	- - - 3871	0 =	241	15	0
The produce of the space, ditto - -	5	$2\frac{3}{4}$					
The weight of nutritive matter which is lost by leaving the crop till the seed be ripe, exceeding one-half of its value, is - - - - - - - - - -			332		5	7	

This grass springs early, but the produce is inconsiderable, compared to that of many others equally nutrient. It is seldom, or, according to my experience, never found in a natural state, except in woods and under the shade of trees. Nevertheless, the seeds vegetate readily when sown on exposed situations, and the plants grow freely, and attain to a greater size and strength, than those in the woods and in the shade. It is singular, that before the period of coming into flower, the plants that are thus cultivated, are invariably attacked by the disease termed *rust*, which pervades every part of the plant. In moist and cloudy seasons the disease is much less severe, being chiefly confined to the leaves. I never could observe the least trace of this affection in the plants of this species, while in their natural place of growth. The Tall Oat-like Soft-grass, *(Holcus avenaceus)*, which affects the shade, and is subject to the above disease, is always free from this affection when growing in the shade. It is likewise precisely the case with the *Agrostis stolonifera*, var. *Sylvatica*, or Wood stoloniferous Bent-grass. There are grasses which are also peculiarly confined to woods or shady situations, but which continue free from this disease when transplanted to exposed situations, as the Wood Millet-grass, *(Milium effusum)*; hairy Wood Brome-grass, *(Bromus hirsutus)*; and Tall Brome-grass, *(Bromus giganteus)*. There exists no difference in the structure of those grasses subject to the disease, to distinguish them

Poa nemoralis.
Wood Meadow-grass.

from those that are always affected by it when transplanted to exposed situations, only that the former grasses are smooth, or have their surface free from hairs; while the latter are in general hairy, or have their surface furnished with numerous hairs. The *Bromus sylvaticus*, (Wood Brome-grass), and *Festuca pinnata*, (spiked Wood Fescue), are subject to the rust likewise, when taken from their natural places of growth: these grasses have hairs, but they are minute, and thinly scattered on the leaves.

The Wood Meadow-grass flowers in the third week of June, and ripens the seed in the end of July.

Poa angustifolia. Narrow-leaved Meadow-grass.

Specific character: Panicle diffused; spikets 4-flowered, pubescent; culm erect, round. Linn. Spec. 99.

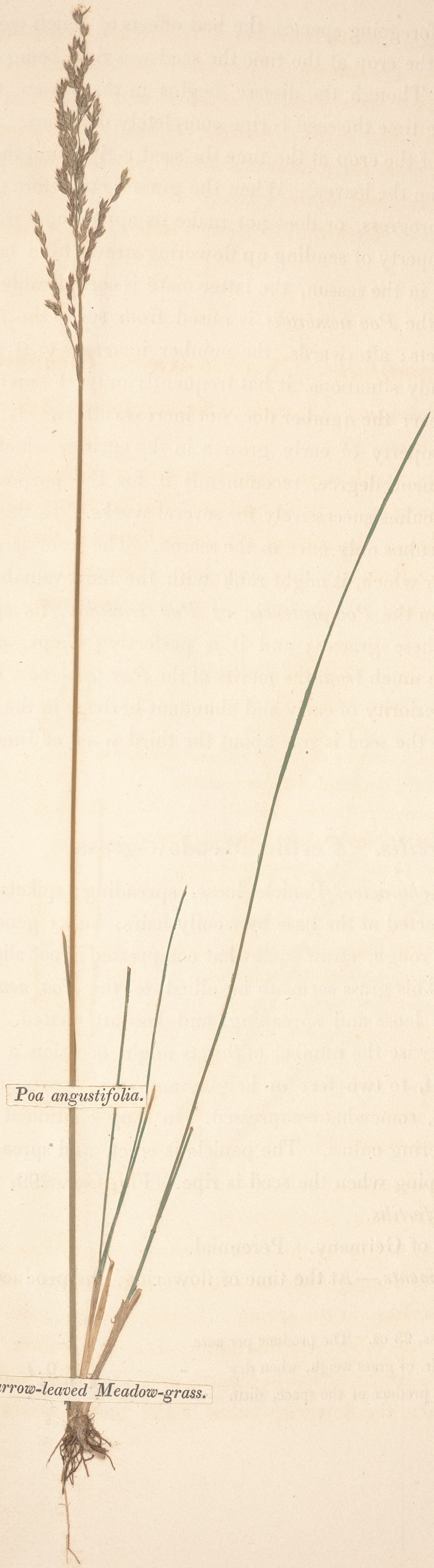
Obs.—Dr. Smith regards this as a variety of the *Poa pratensis;* but as it differs much from that species in its agricultural merits, being much superior, I have rather followed Dr. Willdenow, in keeping it a distinct species, that it may more readily impress the memory. Native of Britain. Root creeping. Perennial.

Experiments.—At the time of flowering, the produce from a brown loam, is,

	dr.	qr.	oz.	lbs.
Grass, 27 oz. The produce per acre - - - - -			294030 0 =	18376 14 0
80 dr. of grass weigh, when dry - -	34	0	- - 124962 12 =	7810 2 12
The produce of the space, ditto - -	183	$2\frac{2}{5}$		
The weight lost by the produce of one acre in drying - - - -				10566 11 4
64 dr. of grass afford of nutritive matter -	5	0	- - 22886 11 =	1430 6 11
The produce of the space, ditto - -	33	3		
At the time the seed is ripe, the produce is,				
Grass, 14 oz. The produce per acre - - - -			152460 0 =	9528 12 0
80 dr. of grass weigh, when dry - -	32	0	- - 60984 0 =	3811 8 0
The produce of the space, ditto - -	89	$2\frac{2}{5}$		
The weight lost by the produce of one acre in drying - - - - - - -				5717 4 0
64 dr. of grass afford of nutritive matter -	5	1	- - 12506 7 =	781 10 7
The produce of the space, ditto - -	18	$1\frac{1}{2}$		
The produce of latter-math is,				
Grass, 18 oz. The produce per acre - - - - - -			196020 0 =	12251 4 0
64 dr. of grass afford of nutritive matter -	1	0	- - 3062 13 =	191 6 13
The weight of nutritive matter which is lost by leaving the crop till the seed be ripe, exceeding one-third part of its value, is - - - - - - - -				649 0 4

The proportional value in which the grass, at the time the seed is ripe, exceeds that at the time of flowering, is as 21 to 20.

In the early growth of the leaves of this species of Poa, there is a striking proof that the property of coming early into flower, is not always connected with the early growth and produce of herbage in the spring. In this respect, most of the grasses that have come under examination, are inferior to this now spoken of. Before the middle of April, the leaves attain to more than twelve inches in length, and are tender and succulent. In the month of May, likewise, when the flowering culms make their appearance, it is not subject to the disease that


Poa angustifolia.
Narrow-leaved Meadow-grass.

affects the foregoing species, the bad effects of which were manifested in the great deficiency of produce in the crop at the time the seed was ripe, being one-half less than at the time the grass is in flower. Though the disease begins in the straws, the leaves suffer most from its effects, being at the time the seed is ripe completely dried up. The culms therefore constitute the principal part of the crop at the time the seed is ripe, and they contain more nutritive matter in proportion, than the leaves. When the grass is cut before the time of flowering, the disease makes but small progress, or does not make its appearance if the grass is kept closely cropped. It has the property of sending up flowering-straws till a late period of the season, and when cut only thrice in the season, the latter-math is considerable.

When the *Poa nemoralis* is raised from seed, the first year the calyx contains only from 3 to 5 florets; afterwards, the number increases to 9 florets in each calyx: when raised from seed in shady situations, it has frequently only 2 florets in each calyx, and sometimes only 1, the first year: the number does not increase afterwards to more than 3 florets in each calyx.

The property of early growth in the spring, which this grass, *Poa angustifolia*, possesses in an eminent degree, recommends it for the purpose of permanent pasture. It sends up flowering culms successively for several weeks. In this it differs from the *Poa pratensis*, which produces culms only once in the season. The root is as powerfully creeping as that species, and but for which, it might rank with the most valuable grasses. It contains more nutritive matter than the *Poa pratensis*, or *Poa trivialis*. Its spring produce is nearly double that of either of these grasses; and it is perfectly exempt, as before observed, from any disease that detracts so much from the merits of the *Poa nemoralis*, which nearest approaches to this species, in the superiority of early and abundant herbage in the spring. It flowers towards the end of May, and the seed is ripe about the third week of June.

Poa fertilis. Fertile Meadow-grass.

Specific character: Panicle loose, spreading; spikets oval, spear-shaped, 5-flowered; florets connected at the base by woolly hairs; husks generally 5-nerved, sheaths of the culms a little rough, straw somewhat compressed; root slightly creeping.

Obs.—This grass seems to be allied to the *Poa nemoralis*. It differs in having the panicle more loose and spreading, and less attenuated. The spikets are more oval and nerved, otherwise the number of florets might occasion a doubt. The culm rises from a foot and a half, to two feet in height, and sometimes more; ascending at the base, afterwards erect, somewhat compressed. In long continued moist weather the lower joints send up flowering culms. The panicle is erect, and spreading when in flower, but contracted and drooping when the seed is ripe. Flo. Ger. 299, *Poa serotina*; Host. v. 3, p. 10, t. 13, *Poa fertilis*.

Native of Germany. Perennial.

Experiments.—At the time of flowering, the produce from a sandy loam, is,

	dr.	qr.		oz.		lbs.	
Grass, 23 oz. The produce per acre - - - - - -				250470	0 =	15654	6 0
80 dr. of grass weigh, when dry - -	34	0					
The produce of the space, ditto - -	156	$1\frac{3}{5}$	- -	106449	3 =	6653	1 3

Poa fertilis.

Fertile Meadow-grass.

affects the foregoing species, the bad effects of which were manifested in the great deficiency of produce in the crop at the time the seed was ripe, being one-half less than at the time the grass is in flower. Though the disease begins in the straws, the leaves suffer most from its effects, being at the time the seed is ripe completely dried up. The culms therefore constitute the principal part of the crop at the time the seed is ripe, and they contain more nutritive matter in proportion, than the leaves. When the grass is cut before the time of flowering, the disease makes but small progress, or does not make its appearance if the grass is kept closely cropped. It has the property of sending up flowering-straws till a late period of the season, and when cut only thrice in the season, the latter-math is considerable.

When the *Poa nemoralis* is raised from seed, the first year the calyx contains only from 3 to 5 florets; afterwards, the number increases to 9 florets in each calyx: when raised from seed in shady situations, it has frequently only 2 florets in each calyx, and sometimes only 1, the first year: the number does not increase afterwards to more than 3 florets in each calyx.

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Native of Germany. Perennial.

Experiments.—At the time of flowering, the produce from a sandy loam, is,

	dr.	qr.		oz.		lbs.		
Grass, 23 oz. The produce per acre - - - - - -				250470	0 =	15654	6	0
80 dr. of grass weigh, when dry - -	34	0	}					
The produce of the space, ditto - -	156	$1\frac{3}{5}$	}	106449	3 =	6653	1	3

	dr.	qr.		oz.		lbs.		
The weight lost by the produce of one acre in drying - - - - - -						9000	14	0
64 dr. of grass afford of nutritive matter -	3	0	- -	11740	12 =	733	12	12
The produce of the space, ditto - -	17	1						
At the time the seed is ripe, the produce is,								
Grass, 22 oz. The produce per acre - - - -				239580	0 =	14973	12	0
80 dr. of grass weigh, when dry -	44	0	- -	131769	0 =	8235	9	0
The produce of the space, ditto - -	193	$2\frac{2}{3}$						
The weight lost by the produce of one acre in drying - - - -						6738	3	0
64 dr. of grass afford of nutritive matter -	5	0	- -	18717	3 =	1169	13	3
The produce of the space, ditto - -	27	2						
The weight of nutritive matter, in which the crop at the time the seed is ripe, exceeds that at the time of flowering, is - - - - - - - -						436	0	7
The nutritive matter contained in the grass at the time the seed is ripe, exceeds that in the grass at the time of flowering, in the proportion of 5 to 3.								
The produce of latter-math is,								
Grass, 7 oz. The produce per acre - - - - -				76230	0 =	4764	6	0
64 dr. of grass afford of nutritive matter -	1	2	per acre -	1786	10 =	111	10	10
On the 6th of April, the produce is,								
Grass, 8 oz. The produce per acre - - - -				87120	0 =	5445	0	0
64 dr. of grass afford of nutritive matter -	3	3	- -	5104	11 =	319	0	11

The proportional value which the grass of the latter-math bears to that at the time of flowering, is as 6 to 3; and to the grass at the time the seed is ripe, as 10 to 3.

In regard to early growth, this grass stands next to the Meadow-foxtail, Cock's-foot, and Tall Oat. The herbage is more nutritive than that of either of these grasses. It will appear remarkable, that the grass of the latter-math should contain more nutritive matter than the grass at the time of flowering, but this is owing to the property it possesses, of sending forth a succession of flowering culms till the frost arrests it; and hence the trivial names, *fertilis*, and *serotina*, fertile, and late-flowering Meadow-grass, quoted above. M. Host* mentions, that it is natural to moist pastures and the banks of rivers; and Schrader remarks also, that in Germany it grows in meadows, vineyards, marshes, walls, and elsewhere, not unfrequently. I have found it to grow on almost every kind of soil; but it attains to the greatest perfection in a rich moist one. Hares and rabbits are very fond of it. It is one of those grasses that thrive best when combined with others: it will not make a superior turf of itself, but it adds much to the value of a sward, from its nutritive qualities, and powers of early and late growth. As it perfects an abundance of seed, it may be easily propagated.

By comparing its produce of nutritive matter from one acre, with those of the Cock's-foot, Meadow-foxtail, and Sweet-scented Vernal Grasses, it will be found superior to Foxtail in the proportion of 5 to 3, and only inferior to the Cock's-foot in the proportion of 7 to 5.

Sir Humphry Davy has shewn that its nutritive matter consists of mucilage 65; saccharine matter, or sugar, 6; extractive matter 7 = 78.

From these facts and observations it will appear, that the Fertile Meadow-grass deserves a place in the composition of rich pastures, and ranks with the superior grasses of irrigated meadows.

It flowers in the beginning of July, and the seed is ripe towards the end of the month.

* Nic. Thomæ Host icones et Descriptiones Graminum Austriacorum.

Lathyrus pratensis.
Yellow Vetchling.

Lathyrus pratensis. Yellow Vetchling, Tare Everlasting.

Specific character: Tendrils with 2 leaves, quite simple; leafets spear-shaped. Tendrils sometimes 3-cleft. (Linn.)

Native of Britain. Root creeping. Perennial. E. Bot. 670; Fl. Dan. 527; Wither. Arr. v. ii. p. 619; Anderson's Essays.

Experiments.—At the time of flowering, the produce from a clayey loam, is,

	dr.	qr.	oz.		lbs.	
Herbage, 36 oz. The produce per acre - - - -			392040	0 =	24502	8 0
80 dr. of herbage weigh, when dry -	40	0	196020	0 =	12251	4 0
The produce of the space, ditto - -	288	0				
The weight lost by the produce of one acre in drying - - - -					12251	4 0
64 dr. of herbage afford of nutritive matter -	2	1	13782	10 =	861	6 10
The produce of the space, ditto - -	20	1				

The merits of this vetchling, in point of produce and nutrient qualities, appear by the following comparison, to be much inferior to those of the Red or Broad-leaved cultivated Clover:

			lbs.
Trifolium pratense, Broad-leaved cultivated Clover,	affords per acre	Green food - - - - - -	49005
		Hay - - - - - - - -	12251
		Nutritive matter - - - - -	1914

The Red Clover, therefore, exceeds in value that of the Yellow Vetchling, in the proportion nearly of 7 to 3. The weight of hay afforded by the Yellow Vetchling, is equal to that afforded by the Red Clover, which arises from the greater quantity of superfluous moisture contained in the latter, and the greater proportion of woody fibre in the produce of the former: hence one pound of the hay of Red Clover contains 40 dr. of nutritive matter, while an equal weight of the Yellow Vetchling hay contains only 17 dr. 2 grains.

This vetchling is not unfrequent in good pastures and in rich meadows: it delights in moisture, and it attained to the greatest perfection in a tenacious clayey soil. It is a late-springing plant, and the shoots come up thinly, but attain to a great length. It appears to be eaten by oxen, cows, and sheep, but with less relish than they seem to have for the *Vicia sepium,* (creeping vetch), or the Red and White Clovers. The nutritive matter it affords contains a much greater proportion of insoluble and bitter extractive matters than the plants now mentioned. It affords little or no sugar. One hundred parts of the nutritive matter submitted to the action of cold and boiling water, and alcohol, separately, afforded me:

Mucilage - - - - - - - - -	37
Bitter extractive and saline matters - - - - - -	31
Saccharine matter - - - - - - - -	2
Insoluble matter - - - - - - - -	30
	100

Sir H. Davy has shewn, that Red Clover contains in every 100 parts of its nutritive matter,

Mucilage, or starch - - - - - - -	79½
Saccharine matter, or sugar - - - - - - -	7½
Gluten, or albumen - - - - - - -	5
Extract, or insoluble matter - - - - - - -	8
	100

Poa nervata.

Nerved Meadow-grass.

different species that grew around it, remained in a healthy state; but were all inferior, and more or less injured by the severity of the weather. In the following season, the produce rather exceeded the above, though it had been mown the preceding season, and no manure had been applied. It is a native of North America, where the winters are longer or more severe, and the summers warmer than in this climate; and the plants, natives of Siberia, exhibit a similar habit, for the severer the winter, the greater is their produce, and the milder the winter, their produce is comparatively less. The long-rooted Clover is one of this class: after a severe winter the produce is very great, but after a mild winter the produce is considerably inferior.

The Nerved Meadow-grass affects most soils, but not such as are tenacious. The seed does not vegetate so readily as might be presumed, from the plentiful manner in which it is produced; nor does the plant attain to maturity so soon as many other grasses that have equal merits in other respects. The above facts do not offer sufficient grounds to recommend the Nerved Meadow-grass strongly, for the purposes of the Agriculturist; nor go the full length to discourage farther attempts to cultivate it to more advantage, as it is a foreign plant, and its defects may, probably, be lessened by frequently raising it from seed ripened in this climate.

It flowers in the third week of June, and the seed is ripe in the last week of July.

Poa Cæsia. Sea-green Meadow-grass.

Specific character: Panicle spreading; spikets 5-flowered, husks spear-shaped, silky-edged, unconnected with any web, sheath-scale short and blunt.

Obs.—Culms from six inches to a foot and a half, according to the nature of the soil it grows in. The leaves are bluntish, flat and smooth on the back next the base, but in other parts rugged; sheaths the length of the leaves, striated, somewhat rugged. It seems to be very different from the *Poa glauca* in the Flora Danica, that approaches nearer to the *Poa nemoralis.* (Dr. Smith). E. Bot. 1719.

Native of Scotland. Root fibrous. Perennial.

Experiments.—At the time of flowering, the produce from a brown loam, is,

	dr.	qr.		oz.		lbs.		
Grass, 10 oz. The produce per acre - - - -				108900	0 =	6806	4	0
80 dr. of grass weigh, when dry - -	34	0						
The produce of the space, ditto - -	68	0	- -	46282	8 =	2892	10	0
The weight lost by the produce of one acre in drying - - - - - - -						3913	10	0
64 dr. of grass afford of nutritive matter -	2	1						
The produce of the space, ditto - - -	5	2½	- - -	3867	9 =	241	11	9
At the time the seed is ripe, the produce is,								
Grass, 7 oz. the produce per acre - - - - -				76230	0 =	4764	6	0
80 dr. of grass weigh, when dry - -	40	0						
The produce of the space, ditto - -	56	0	- -	38115	0 =	2382	3	0
The weight lost by the produce of one acre in drying - - - -						2382	3	0
64 dr. of grass afford of nutritive matter -	3	0						
The produce of the space, ditto - -	5	1	- -	3573	4 =	223	5	4
The weight of nutritive matter, in which the produce of one acre, at the time of flowering, exceeds that at the time the seed is ripe, is, - - - - -						18	6	5

Poa cæsia.

Sea-green Meadow-grass.

The weight of grass at the time the seed is ripe, is less than that at the time of flowering, which at first sight appears contrary to what might have been expected, as the grass had at least three weeks of growth more than that of the flowering crop. But after the time of flowering, the leaves do not appear to increase, but rather diminish, many of them becoming completely dry before the seed be perfected. The culms retain their succulency, and become heavier till the seed be ripe, which points out the true cause of the superior quantity of nutritive matter contained in the grass of the seed crop.

Dr. Smith informs us, that it is an Alpine plant, and only as yet found a native of Scotland, where it was found by Mr. Mackay, on Ben Lawers. It appears, however, to be easily cultivated on soils of an intermediate quality as to moisture and dryness. Its seed is good, and produced in plenty.

The above details prove this grass to be capable of cultivation; but possessed of no excellence in a sufficient degree to render it worthy of a place in the composition of good pasture.

It flowers in the third week of June, and the seed is ripe about the second and last week of July, according to the state of the weather.

Poa glauca. Glaucous Meadow-grass.

Specific character: Panicle glaucous, slender, erect, silky-edged, unconnected with any web; spikets very short.

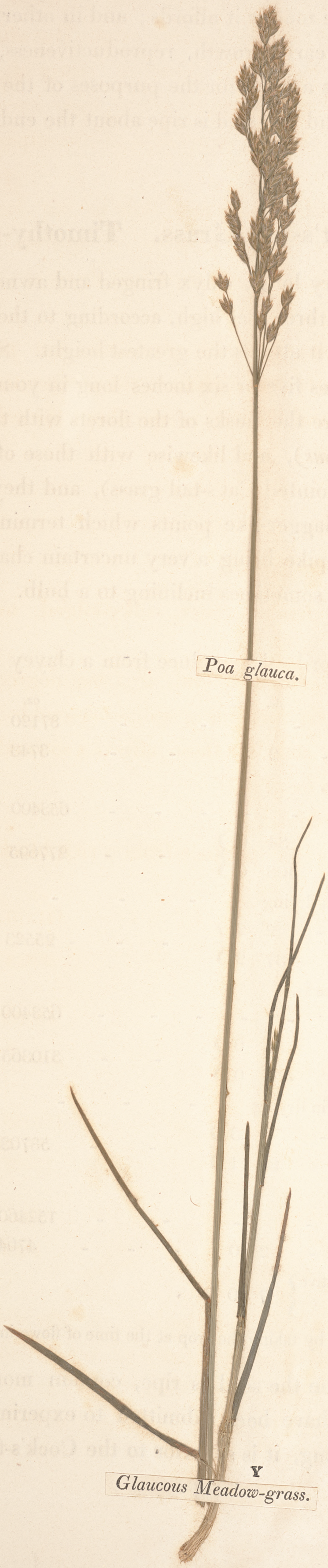
Obs.—This species resembles the *Poa nemoralis*, and, in a less degree, the *P. trivialis*, and likewise affects a similar soil; while the preceding species resembles more the *Poa alpina*, *Poa subcœrulea*, and *Poa pratensis*, and, like these, affects a somewhat drier soil. Culms from a foot and a half to two feet in height.

Native of Britain. Root fibrous. Perennial.

Experiments.—At the time of flowering, the produce from a rich black sandy loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 13 oz. The produce per acre is - - - - -			141570	0 =	8848	0	0
80 dr. of grass weigh when dry - -	32	0					
The produce of the space, ditto - -	83	1	56628	0 =	3539	4	0
64 dr. of grass afford of nutritive matter -	2	2					
The produce of the space, ditto - -	8	0½	5530	1 =	345	10	0
The weight lost by the produce of one acre in drying - - - -			5308	14	0		
At the time the seed is ripe, the produce is,							
Grass, 15 oz. The produce per acre - - - -			163350	6 =	10209	6	0
80 dr. of grass weigh, when dry - -	36	0					
The produce of the space, ditto - -	108	0	73507	8 =	4594	3	8
The weight lost by the produce of one acre in drying - - - - -			5615	2	8		
64 dr. of grass afford of nutritive matter -	2	3					
The produce of the space, ditto - -	10	1¼	7018	15 =	438	10	15

This grass is said to be a native of the North of England, and Scotland. It inhabits alpine situations, but is easily propagated, as it perfects plenty of seed, which vegetates freely on almost every kind of soil. It grows to a larger size than the Sea-green Meadow-grass; and if the above details of its produce, and nutritive powers, be compared with those of that grass, it



Poa glauca.

Y

Glaucous Meadow-grass.

will be found greatly superior. But it is still much inferior to a great number of grasses, in the quantity of herbage, hay, and of nutritive matter it affords; and in other respects it possesses no superior merit, either with respect to early growth, reproductiveness, or late growth. It cannot therefore as yet be recommended as a plant for the purposes of the Agriculturist.

It flowers in the third week of June, and the seed is ripe about the end of July.

Phleum pratense. Meadow Cat's-tail Grass. Timothy-grass.

Specific character: Spike cylindrical, very long; calyx fringed and awned; straws upright.

Obs.—Culms from a foot and a half to three feet high, according to the nature of the soil in which it grows; in moist deep loams it attains the greatest height. Spike regularly cylindric, and blunt at the top; sometimes five or six inches long in young plants, but in old plants it is much shorter. Compare the husks of the florets with those of the following variety, *(Phleum pratense,* var. *minus),* and likewise with those of the next following species, *(Phleum nodosum,* bulbous-jointed Cat's-tail grass), and they will be found much shorter and straight in the forks or dagger-like points which terminate them. This is a sure distinction, the length of the spike being a very uncertain character, for the reason just now mentioned. Root fibrous, sometimes inclining to a bulb.

Native of Britain. Perennial.

Experiments.—About the middle of April, the produce from a clayey loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 8 oz. The produce per acre			87120	0 =	5445	0	0
64 dr. of grass afford of nutritive matter	2	3	3743	7 =	223	15	7
At the time of flowering, the produce is,							
Grass, 60 oz. The produce per acre			653400	0 =	40837	8	0
80 dr. of grass weigh, when dry	34	0	277695	0 =	17355	15	0
The produce of the space, ditto	408	0					
The weight lost by the produce of one acre in drying			23481	9	0		
64 dr. of grass afford of nutritive matter	2	2	25523	7 =	1595	3	7
The produce of the space, ditto	37	2					
At the time the seed is ripe, the produce is,							
Grass, 60 oz. The produce per acre			653400	0 =	40837	8	0
80 dr. of grass weigh, when dry	38	0	310365	0 =	19397	13	0
The produce of the space, ditto	456	0					
The weight lost by the produce of one acre in drying			21439	11	0		
64 dr. of grass afford of nutritive matter	5	3	58703	14 =	3668	15	14
The produce of the space, ditto	86	1					
The produce of latter-math is,							
Grass, 14 oz. The produce per acre			152460	0 =	9528	12	0
64 dr. of grass afford of nutritive matter	2	0	4764	6 =	297	12	6
64 dr. of the culms or straws afford of nutritive matter	7	0					
The weight of nutritive matter which is lost by taking the crop at the time of flowering, is,			2073	11	0		

The culms of this grass, at the time the seed is ripe, contain more nutritive matter than those of any other species of grass that have been submitted to experiment. In regard to the production of early herbage in the spring, it is superior to the Cock's-foot grass; the results of

Phleum pratense.
Meadow Cat's-tail grass.

the experiments shewed the quantity of grass to be equal in both plants; but the nutritive matter afforded by the grass of the Meadow Cat's-tail, in the early part of the spring, was superior to that of the Cock's-foot, in the proportion of 9 to 8. The value of the culms simply, exceeds that of the grass, at the time of flowering, in the proportion of 14 to 5; a circumstance which gives value to this grass above many others for the purpose of hay; as its valuable early foliage may be cropped to a late period of the spring without injury to the culms, which cannot be effected with those grasses which flower earlier in the season, without incurring a loss of nearly half the value of the crop, as has been proved by former examples.

Though there is more nutritive matter contained in the seed crop, than in the flowering crop, nevertheless, the loss of latter-math which would have been produced in the time the seed was ripening, would more than outweigh the superior quantity of nutritive matter contained in the grass of the seed crop. To the practical Farmer this last observation, (which likewise applies to every similar statement throughout these details), is, I am sure, unnecessary. If the season has been dry, this grass should be cut at the time of flowering; but in moist cloudy seasons it should be suffered to stand at least eight days after the period of flowering; in two days after this period it will accumulate more nutritive matter than it did in ten days previous to that stage of growth, provided circumstances do not interrupt the progress of vegetation, which the results of numerous experiments have proved.

This grass is very deficient in the produce of after-math, and is slow in growth after being cropped: these defects take much from the merits above-mentioned. It appears, therefore, to be unfit for cultivation by itself as an alternate husbandry grass, but of great value, as a constituent of any mixture of grasses for permanent pasture, or the alternate husbandry, where it should always form a part.

In the Annual Register for 1765, we find that it was much recommended about fifty years ago, under the name of Timothy-grass; and Mr. Wynch is said to have brought it from Virginia in 1763. It received this quaint appellation from Mr. Timothy Hanson, who first brought its seeds from New-York to Carolina. It had then a great character in America, where it is called Herd-grass. I am now (1815) informed by a proprietor of land in Canada, that it is still considered the best grass in that kingdom.

It flowers in the third week of June, and ripens the seed in the end of July.

Phleum pratense, var. *minus*. Smaller variety of Meadow Cat's-tail Grass.

Obs.—This differs from the preceding variety in the dagger-like points which terminate the husks, these being longer in this variety, and more recurved or bent outwards; the husks are larger in every respect, and less ciliated. Culms almost covered with the sheaths of the leaves; joints of the culm less swoln; not upright, but ascending, and the root is more like a bulb. These distinctions have continued stedfast after the plant has been twice raised from seed. The annexed specimen was produced from the second sowing. The foregoing specimen of the first variety is also of the second sowing; both varieties were raised on the same soil, and, indeed, on the same bed of earth.

Native of Britain. Root perennial.

Phleum pratense, var. *minus*.

Smaller variety of Meadow Cat's-tail.

Experiments.—At the time of flowering, the produce from a clayey loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 22 oz. The produce per acre, is - - - -			239580	0 =	14973	12	0
80 dr. of grass weigh when dry - -	40	0	119790	0 =	7486	14	0
The produce of the space, ditto - -	176	0					
The weight lost by the produce of one acre in drying - - - -			7486	14	0		
64 dr. of grass afford of nutritive matter -	66 gr.*		8235	9 =	514	11	9
The produce of the space, ditto - -	363						
At the time the seed is ripe, the produce is,							
Grass, 40 oz. The produce per acre - - - -			435600	0 =	27225	0	0
	dr.	qr.					
80 dr. of grass weigh, when dry - -	34	0	185130	0 =	11570	10	0
The produce of the space, ditto - -	272	0					
The weight lost by the produce of one acre in drying - - - -			15654	6	0		
64 dr. of grass afford of nutritive matter -	2	3	18717	3 =	1169	13	3
The produce of the space, ditto - -	27	2					
The produce of latter-math is,							
Grass, 14 oz. The produce per acre - - - -			152460	0 =	9528	12	0
64 dr. of grass afford of nutritive matter -	1	2	3573	4 =	223	5	4

A comparison will shew, how inferior this smaller variety of Meadow Cat's-tail grass is to the larger variety.

The larger Meadow Cat's-tail grass, as before, affords of nutritive matter from the produce of one acre:

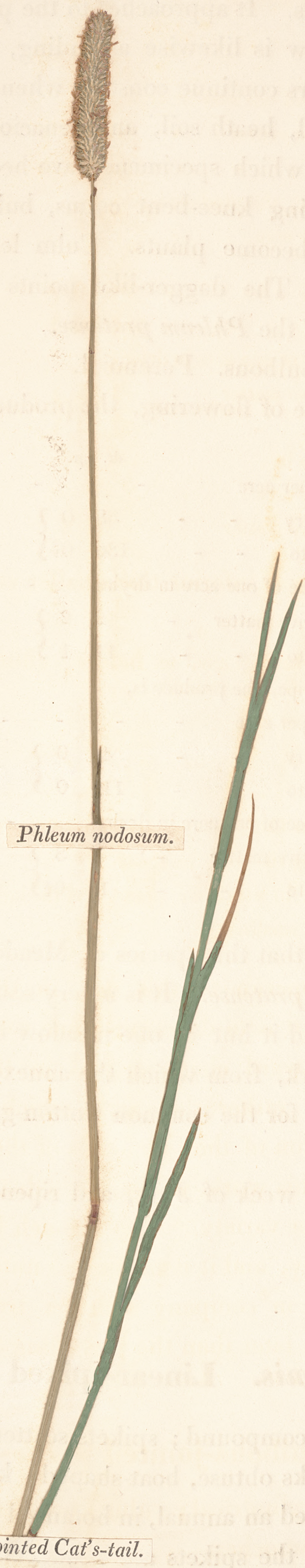
	lbs.	lbs.
At the time of flowering - - - - - - -	1595	5263
At the time the seed is ripe - - - - - - -	3668	
The smaller variety of Meadow Cat's-tail grass affords, from the produce of one acre at the time of flowering and ripening the seed, as above - - - - -		1684
The weight of nutritive matter, in which the produce of the larger variety of Meadow Cat's-tail grass exceeds that of the smaller, is - - - - - -		3579

Or, the former grass is superior to this one, in the proportion nearly of 25 to 8. This shews how important a point it is to distinguish one variety of grass from another, when they are so very much alike in outward characters, as in the above instance. The seeds are also very similar to each other, or rather the marks which distinguish them from each other, are minute. A careful examination of the specimens of these seeds (No. V. and No. XXVII.) as given in the Introduction to this work, will assist in distinguishing the seed of the true Cat's-tail grass from that of the inferior variety. This is much later in the produce of herbage in the spring, than the larger variety, and it is much less nutritive. It is more common on tenacious soils than in such as are rich, in company with the true Meadow Cat's-tail. It flowers and perfects its seed about a week later than the preceding variety.

Phleum nodosum. Bulbous-jointed Cat's-tail Grass.

Specific character: Spike cylindrical; culm knee-bent, furnished with bulbs at the lower joints, which send out branches.

* Of 30 grains to the drachm.



Phleum nodosum.

Bulbous-jointed Cat's-tail.

Obs.—There is still another variety of the *Phleum pratense*, distinct from the preceding, and which may be mistaken for the *Phleum nodosum:* that variety grows on poor clayey soils, particularly by road-sides. It approaches to the present species, in having the root somewhat bulbous; the straw is likewise ascending, but not knee-bent, as in the *Phleum nodosum:* these characters continue constant when the plant is cultivated on different soils, *(i. e.)* on light sandy soil, heath soil, and tenacious clay. It is smaller in every respect than the two varieties of which specimens have been given. The *P. nodosum* differs from the *P. pratense*, in having knee-bent culms, bulbs growing out at the root of the stem-leaves, which in time become plants. Culm leaves shorter and smooth, except at the edges. Anthers white. The dagger-like points of the husk are also longer, and more reflexed than in those of the *Phleum pratense.*

Native of Britain. Root bulbous. Perennial.

Experiments.—At the time of flowering, the produce from a clayey loam, is

	dr.	qr.	oz.		lbs.		
Grass, 18 oz. The produce per acre - - - -			196020	0 =	12251	4	0
80 dr. of grass weigh, when dry - -	38	0	- -	93109	8 =	5819	5 8
The produce of the space, ditto - -	136	0⅘					
The weight lost by the produce of one acre in drying - - - - - -					6431	14	8.
64 dr. of grass afford of nutritive matter -	2	2	- -	7657	0 =	478	9 0
The produce of the space, ditto - -	11	1					
At the time the seed is ripe, the produce is,							
Grass, 14 oz. The produce per acre - - - - - -			152460	0 =	9528	12	0
80 dr. of grass weigh, when dry - -	40	0	- -	76230	0 =	4764	6 0
The produce of the space, ditto - -	112	0					
The weight lost by the produce of one acre in drying - - - -					4764	6	0
64 dr. of grass afford of nutritive matter -	3	3	- - -	8933	3 =	558	5 3
The produce of the space, ditto - -	13	0½					

The above details shew, that this species of Meadow Cat's-tail is much inferior even to the lesser variety of the *Phleum pratense.* It is a very scarce grass, at least as far as my researches have extended, having found it but in one meadow in a wild state. It grows in a clayey soil near a spring in Woburn-park, from which the annexed specimen was propagated. Hares and rabbits neglected this grass for the common Cotton-grass, *(Eriophorum angustifolium)*, which grew closely adjoining.

It flowers in the second week of July, and ripens the seed in the end of the same month; but the seed is seldom good.

Cynosurus erucæformis. Linear-spiked Dog's-tail Grass.

Specific character: Spike compound; spikets scattered, the fruit-bearing ones erect; calices 1 and 2-flowered; husks obtuse, boat-shaped; keel obtuse; corollas acuminate.

Obs.—This grass is marked an annual, in botanical works, but it is strictly perennial. Before the time of flowering, the spikets are beautifully tinged with crimson on the sides; it

Cynosurus erucæformis.

Linear-spiked Dog's-tail.

deserves a place in the flower-garden, on account of the singularity and beauty of the spike.

Native of Germany, Russia, and Hudson's Bay. Root fibrous. Perennial. Hort. Kew.; Host. t. 6. *Beckmannia erucæformis.*

Experiments.—At the time of flowering, the produce from a clayey loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 10 oz. The produce per acre - - - -			108900	0 =	6806	4	0
80 dr. of grass weigh, when dry - -	34	0	- -	46282	8 =	2892	10 8
The produce of the space, ditto - -	68	0					
The weight lost by the produce of one acre in drying - - - -				3903	9	8	
64 dr. of grass afford of nutritive matter -	103 gr.		- - -	5867	0 =	365	2 0
The produce of the space, ditto - -	257½						

At the time the seed is ripe, the produce is,

	dr.	qr.	oz.		lbs.		
Grass, 18 oz. The produce per acre - - - - - -			196020	0 =	12251	4	0
80 dr. of grass weigh, when dry -	36	0	- -	88209	0 =	5513	1 0
The produce of the space, ditto - -	129	2⅖					
The weight lost by the produce of one acre in drying - - - -				6738	3	0	
64 dr. of grass afford of nutritive matter -	3	1	- -	9954	2 =	622	2 2
The produce of the space, ditto - -	14	2½					

The produce at the time the seed is ripe, as above stated, was taken the season preceding that in which the flowering crop was submitted to experiment; and as the season of 1812, in which the seed crop was ascertained, happened to be more favourable to the growth of this grass than that of 1813, when the flowering crop was experimented upon and the seed crop likewise, according to the following details of results; it will be more just to compare the produce of the crops of the same season.

At the time the seed is ripe, the produce of the season in which the flowering crop was ascertained, is,

	dr.	qr.	oz.		lbs.		
Grass, 9 oz. The produce per acre - - - -			98010	0 =	6125	10	0
80 dr. of grass weigh, when dry - -	36	0	- -	44104	8 =	2750	4 8
The produce of the space, ditto - -	64	3⅕					
The weight lost by the produce of one acre in drying, is - - - -				3375	5	8	
64 dr. of grass afford of nutritive matter -	103 gr.		- -	5257	13 =	328	9 13
The produce of the space, ditto - -	231¾						
The weight of nutritive matter in which the crop, at the time the seed is ripe, exceeds that at the time of flowering, is - - - - - - - - - - - -						293	8 5

Or superior to the crop, at the time of flowering, in the proportion nearly of 2 to 1.

The produce of latter-math, is,

	dr.	qr.	oz.		lbs.		
Grass, 4 oz. 8 dr. The produce per acre - - - - - -			49005	0 =	3062	13	0
64 dr. of grass afford of nutritive matter -	2	0	- - -	1531	6 =	95	11 6

I have never been able to obtain any seed from this grass, that, when sown, would vegetate, though in general it appears good to the eye. I have tried it on three different soils, but without success. It thrives best on a rich deep loam, and next to that, on a clayey loam: when cultivated on a sandy siliceous soil, the produce is very inferior; on this account it is introduced in

this place. It might be propagated to any extent by parting the roots; but its merits, as will appear from the above details, do not warrant any recommendation to that effect, but rank it with the inferior grasses.

It flowers in the third week of June, and the seed is perfected about the third week of July.

Triticum caninum. Bearded Wheat-grass.

Specific character: Valves of the calyx pointed, five-nerved, four flowers in each calyx; florets awned; leaves flat.

Obs.—This differs essentially from the common couch-grass, *(Triticum repens)*, in having the root fibrous; the awns are also much longer than those of the awned variety of common couch, *(Triticum repens,* var. *aristatum).* E. Bot. 1372.

Native of Britain. Root fibrous. Perennial.

Experiments.—At the time of flowering, the produce from a sandy loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 18 oz. The produce per acre - - - -			196020	0 =	12251	4	0
80 dr. of grass weigh, when dry - -	32	0	- - 78408	0 =	4900	8	0
The produce of the space, ditto - -	115	$0\frac{4}{5}$					
The weight lost by the produce of one acre in drying - - - -			7350	12	0		
64 dr. of grass afford of nutritive matter -	2	2	- - 7657	0 =	478	9	0
The produce of the space, ditto - -	11	1					

At the time the seed is ripe, the produce is,

Grass, 16 oz. The produce per acre - - - -			174240	0 =	10890	0	0
80 dr. of grass weigh, when dry - -	46	0	- - 100188	0 =	6261	12	0
The produce of the space, ditto - -	147	$0\frac{4}{5}$					
The weight lost by the produce of one acre in drying - - - - - -			4628	4	0		
64 dr. of grass afford of nutritive matter -	2	0	- - 5445	0 =	340	5	0
The produce of the space, ditto - -	8	0					

At the time of flowering, the produce in the same year that the above seed crop was ascertained, consisted of:

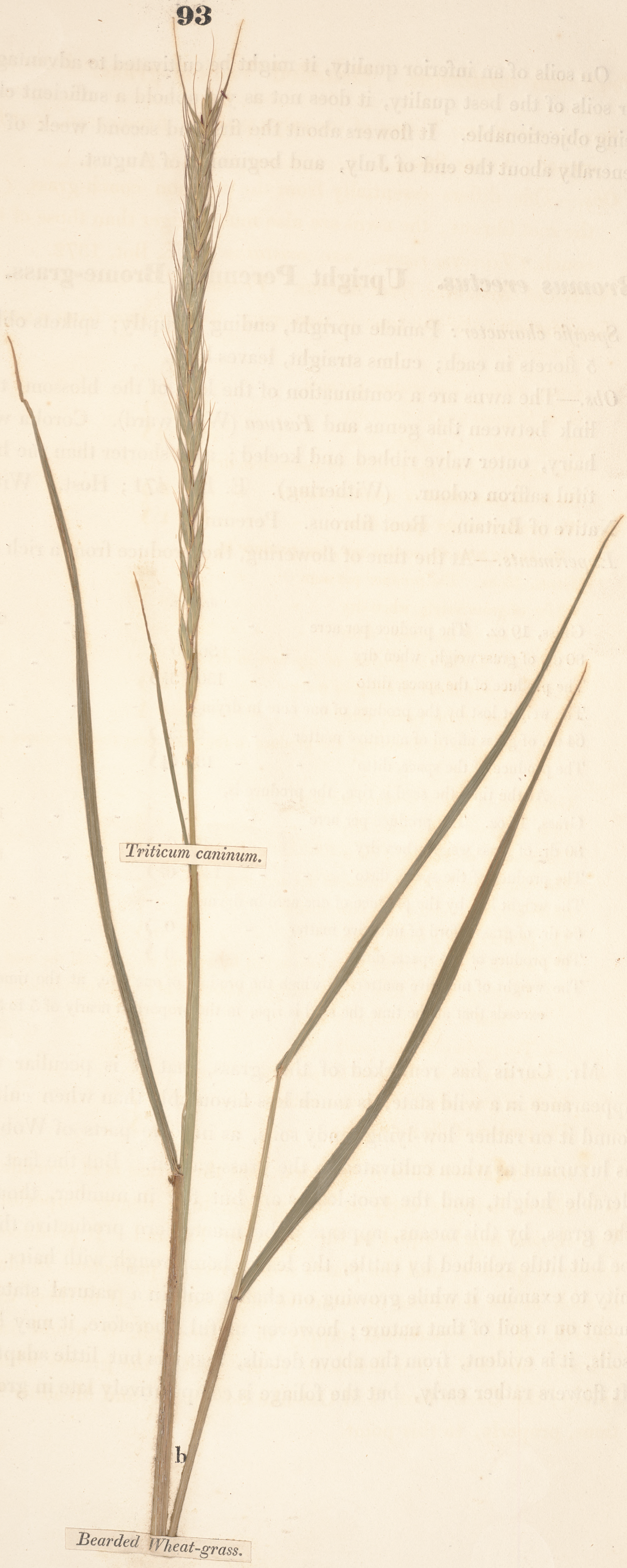
Grass, 16 oz. The produce per acre - - - - - -			174240	0 =	10890	0	0
80 dr. of grass weigh, when dry - -	46	0	- - 100188	0 =	6261	12	0
The produce of the space, ditto - -	147	$0\frac{4}{5}$					
The weight lost by the produce of one acre in drying - - - - - -			4628	4	0		
64 dr. of grass afford of nutritive matter -	2	2	- - - 6806	4 =	425	6	4
The produce of the space, ditto - - -	10	0					
The weight of nutritive matter which is lost by leaving the crop till the seed be ripe, is, -			85	1	4		

The crop, at the time of flowering, is therefore of greater proportional value than that at the time the seed is ripe, nearly as 6 to 5.

The produce of latter-math is,

Grass, 4 oz. 8 dr. The produce per acre - - - - -			49005	0 =	3062	13	0
64 dr. of grass afford of nutritive matter -	2	0	- - 1531	1 =	95	11	1
The produce of the space, ditto - -	2	1					

From the above facts it appears, that this grass is of considerable value, more particularly as it affords herbage early in the spring, in a degree superior to Rye-grass, Sweet-scented Vernal, and nearly equal to the Meadow Fox-tail. It produces a sufficiency of seed, which vegetates quickly, and the plants soon arrive at perfection in almost every kind of soil, except in such as are tenacious or retentive of moisture. If to these valuable properties it added late growth, or a proportional supply of latter-math, it would rank high among the superior grasses; but in this it is deficient, as are most of the grasses which produce early foliage in the spring: the Cock's-foot, Tall Oat-like Soft-grass, and Meadow Soft-grass, are the only exceptions, properly, to this point.


Triticum caninum.
b
Bearded Wheat-grass.

On soils of an inferior quality, it might be cultivated to advantage instead of Rye-grass; but for soils of the best quality, it does not as yet uphold a sufficient claim, the awns of the spike being objectionable. It flowers about the first and second week of July, and the seed is ripe generally about the end of July, and beginning of August.

Bromus erectus. Upright Perennial Brome-grass.

Specific character: Panicle upright, ending abruptly; spikets oblong, hairy, awned, about 5 florets in each; culms straight, leaves hard.

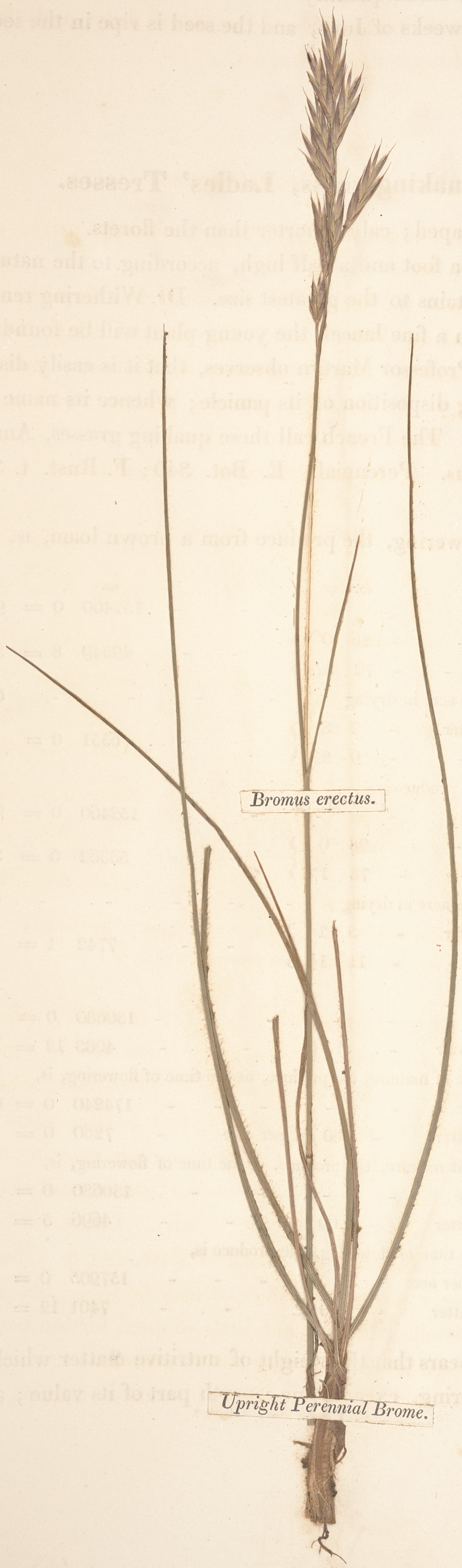
Obs.—The awns are a continuation of the keel of the blossom, thus forming the connecting link between this genus and *Festuca* (Woodward). Corolla with a large knot at the base, hairy, outer valve ribbed and keeled; awn shorter than the blossom; anthers of a beautiful saffron colour. (Withering). E. Bot. 471; Host.; Wither. 2d ed. p. 160.

Native of Britain. Root fibrous. Perennial.

Experiments.—At the time of flowering, the produce from a rich sandy soil, is,

	dr.	qr.	oz.		lbs.		
Grass, 19 oz. The produce per acre			206910	0 =	12931	14	0
80 dr. of grass weigh, when dry	36	0	93109	8 =	5819	5	8
The produce of the space, ditto	136	$3\frac{1}{5}$					
The weight lost by the produce of one acre in drying			7112	8	8		
64 dr. of grass afford of nutritive matter	2	3	8890	10 =	555	10	10
The produce of the space, ditto	13	$0\frac{1}{4}$					
At the time the seed is ripe, the produce is,							
Grass, 16 oz. The produce per acre			174240	0 =	10890	0	0
80 dr. of grass weigh when dry	46	0	100188	0 =	6261	12	0
The produce of the space, ditto	147	$0\frac{4}{5}$					
The weight lost by the produce of one acre in drying			4628	4	0		
64 dr. of grass afford of nutritive matter	2	0	5445	0 =	340	5	0
The produce of the space, ditto	8	0					
The weight of nutritive matter, in which the produce of one acre, at the time of flowering, exceeds that at the time the seed is ripe, in the proportion nearly of 5 to 3, is,			215	5	3		

Mr. Curtis has remarked of this grass, that it is peculiar to chalky soils, and that its appearance in a wild state, is much less favourable than when cultivated in a garden. I have found it on rather low-lying sandy soils, as in some parts of Woburn-park, where it appeared as luxuriant as when cultivated in the grass-garden. But the fact is, the culms rise to a considerable height, and the root-leaves are but few in number, though growing to some length; the grass, by this means, appears to be much more productive than it really is. It seems to be but little relished by cattle, the leaves being rough with hairs. I have not had an opportunity to examine it while growing on chalky soils in a natural state, nor to submit it to experiment on a soil of that nature; however useful, therefore, it may be found hereafter on chalky soils, it is evident, from the above details, that it is but little adapted for the best pasture land. It flowers rather early, but the foliage is comparatively late in growth.


Bromus erectus.
Upright Perennial Brome.

Pheasants appear very fond of the seed, they pick off the spikets before the seed is perfected. The seed is afforded in very small quantity.

Flowers in the second and third weeks of June, and the seed is ripe in the second and third weeks of July.

Briza media. Common Quaking-grass, Ladies' Tresses.

Specific character: Spikets egg-shaped; calyx shorter than the florets.

Obs.—Stems from half a foot to a foot and a half high, according to the nature of the soil it grows on. In moist soils it attains to the greatest size. Dr. Withering remarks, that if a seed be carefully dissected with a fine lancet, the young plant will be found with its leaves and roots perfectly formed. Professor Martyn observes, that it is easily distinguished as a species of Briza by the shaking disposition of its panicle; whence its name among ancient authors, "*Gramen tremulum.*" The French call these quaking grasses, Amourettes.

Native of Britain. Root fibrous. Perennial. E. Bot. 340; F. Rust. t. 39; Wither. ii. p. 148.

Experiments.—At the time of flowering, the produce from a brown loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 14 oz. The produce per acre - - -			152460	0 =	9528	12	0
80 dr. of grass weigh, when dry - -	26	0					
The produce of the space, ditto - -	72	$3\frac{1}{10}$	49549	8 =	3096	13	8
The weight lost by the produce of one acre in drying - - - -			6431	14	8		
64 dr. of grass afford of nutritive matter -	2	3					
The produce of the space, ditto - -	9	$2\frac{1}{8}$	6551	0 =	409	7	0
At the time the seed is ripe, the produce is,							
Grass, 14 oz. The produce per acre - - - -			152460	0 =	9528	12	0
80 dr. of grass weigh, when dry - -	28	0					
The produce of the space, ditto - -	78	$1\frac{3}{5}$	53362	0 =	3335	1	0
The weight lost by the produce of one acre in drying - - - - -			6193	11	0		
64 dr. of grass afford of nutritive matter -	3	1					
The produce of the space, ditto - -	11	$1\frac{1}{2}$	7742	1 =	483	14	1
The latter-math produce is,							
Grass, 12 oz. The produce per acre is - - - - -			130680	0 =	8167	8	0
64 dr. of grass afford of nutritive matter -	2	0	4083	12 =	255	3	12
From a poor sandy soil destitute of manure, the produce, at the time of flowering, is,							
Grass, 16 oz. The produce per acre - - - - -			174240	0 =	10890	0	0
64 dr. of grass afford of nutritive matter -	80 gr. per acre		7260	0 =	453	12	0
From a moist clayey soil without manure, the produce, at the time of flowering, is,							
Grass, 12 oz. The produce per acre - - - -			130680	0 =	8167	8	0
64 dr. of grass afford of nutritive matter -	69 gr.		4696	5 =	293	8	5
From a rich black loam, at the time of flowering, the produce is,							
Grass, 14 oz. 8 dr. The produce per acre - - - - -			157905	0 =	9869	1	0
64 dr. of grass afford of nutritive matter -	90 gr.		7401	12 =	462	9	12

From the above details, it appears that the weight of nutritive matter which is lost by taking the crop at the time of flowering, exceeds one-seventh part of its value; and the nutritive

Briza media.

Common Quaking-grass.

matter contained in the grass of the seed crop, exceeds that in the flowering grass, in the proportion of 13 to 11, and that of the latter-math as 13 to 8.

The results of the experiments on the three different soils now mentioned, shew this grass to be best fitted for poor soils, and afford one instance, that manure is even hurtful to some grasses. Its nutritive powers are considerable, when compared to other grasses affecting a similar soil. It is eaten by horses, cows, and sheep. These merits, therefore, demand attention, and though it is unfit, comparatively, for rich permanent pasture, yet, for poor sandy, and also for poor tenacious soils, where improvement in other respects cannot be sufficiently effected to fit them for the production of the superior grasses, the Common Quaking-grass will be found of value.

It flowers in the second and third weeks of June, and the seed is ripe about the second week of July.

Bromus inermis. Smooth awnless Brome-grass.

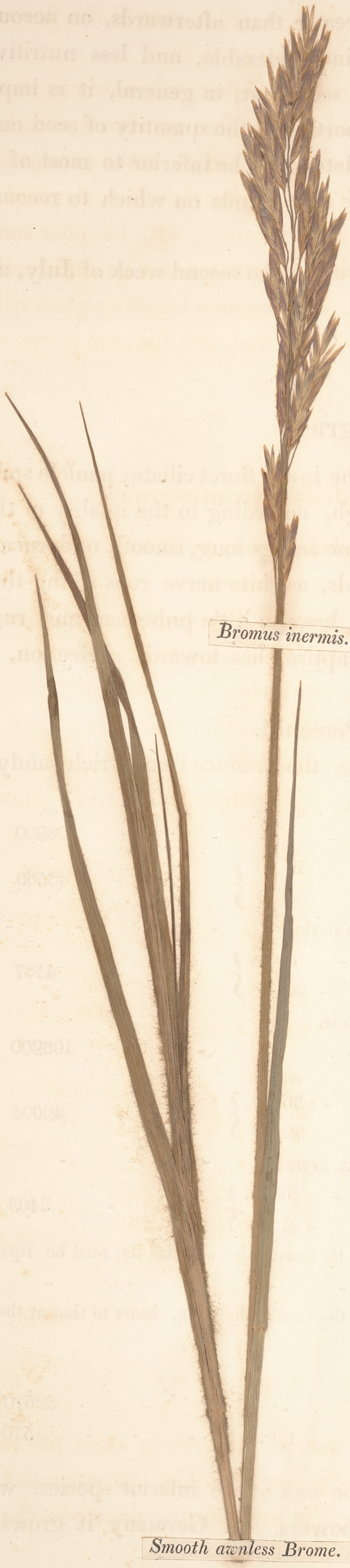
Specific character: Panicle upright; spikets linear, cylindric, naked, awnless, or with very short awns sometimes; imbricated; leaves smooth.

Obs.—Root powerfully creeping, like common Couch-grass; culms from a foot to two feet high, erect, scored, smooth. Leaves broad, acuminate, smooth, dark green, mid-rib whitish, and rough. Panicle from six inches to a foot and more, in length; at first contracted and upright, afterwards nodding. Flo. Ger. 359; Host. t. 9; Hort. Kew. Native of Germany. Root creeping. Perennial.

Experiments.—At the time of flowering, the produce from a black siliceous sandy loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 18 oz. The produce per acre			196020	0 =	12251	4	0
80 dr. of grass weigh when dry	40	0					
The produce of the space, ditto	144	0	98010	0 =	6125	10	0
The weight lost by the produce of one acre in drying					6125	10	0
64 dr. of grass afford of nutritive matter	108 gr.						
The produce of the space, ditto	486¾		11026	2 =	689	2	2
At the time the seed is ripe, the produce is,							
Grass, 18 oz. The produce per acre			196020	0 =	12251	4	0
	dr.	qr.					
80 dr. of grass weigh when dry	35	0					
The produce of the space, ditto	126	0	85758	12 =	5359	14	12
The weight lost by the produce of one acre in drying					6891	5	4
64 dr. of grass afford of nutritive matter	4	1					
The produce of the space, ditto	19	0½	13016	15 =	813	8	15
The produce of latter-math is,							
Grass, 13 oz. The produce per acre			141570	0 =	8848	2	0
64 dr. of grass afford of nutritive matter	1	1					
The produce of the space, ditto	4	0¼	2765	0 =	172	13	0

In Germany, where this grass is a native, it grows in moist pastures, orchards, and by the banks of rivers. Its root is powerfully creeping, like the common Couch-grass, and possesses the property of impoverishing the soil in as eminent a degree as that grass. Its produce,



Bromus inermis.

Smooth awnless Brome.

when first planted on a soil, is much greater than afterwards, on account of its exhausting nature. The produce of early foliage is inconsiderable, and less nutritive than many others. To the eye it produces an abundance of seed, but, in general, it is imperfectly formed, and when sown, produces few plants, in proportion to the quantity of seed employed. The merits of this grass will appear, from the above details, to be inferior to most of the grasses that have already come under observation, and offer no grounds on which to recommend it to the notice of the Agriculturist.

The smooth awnless Brome-grass flowers in the second week of July, and ripens the seed in the second and third weeks of August.

Melica ciliata. Ciliated Melic-grass.

Specific character: The outer petal of the lower floret ciliate; panicle spike-like; spikets erect.

Obs.—Culms from one to three feet high, according to the quality of the soil. Leaves spear-shaped, mucronate, from three to nine inches long, smooth underneath, slightly pubescent above, somewhat rugged downwards, a white nerve runs along the back. Sheath-scale white, cloven; sheaths striated, the lower a little pubescent and rugged, the upper ones smooth and glossy; but as the seed approaches towards perfection, it becomes feathered with long woolly hairs.

Native of Germany. Root fibrous. Perennial.

Experiments.—At the time of flowering, the produce from a rich sandy loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 10 oz. The produce per acre, is - - - -			108900	0 =	6806	4	0
80 dr. of grass weigh, when dry - -	32	0					
The produce of the space, ditto - -	64	0	43560	0 =	2722	8	0
The weight lost by the produce of one acre in drying - - - -			4083	12	0		
64 dr. of grass afford of nutritive matter -	80 gr.						
The produce of the space, ditto - - -	200		4537	8 =	283	9	8

At the time the seed is ripe, the produce is,

	dr.	qr.	oz.		lbs.		
Grass, 10 oz. The produce per acre - - - -			108900	0 =	6806	4	0
80 dr. of grass weigh, when dry - - -	36	0					
The produce of the space, ditto - -	72	0	49005	0 =	3062	13	0
The weight lost by the produce of one acre in drying - - - -			3743	7	0		
64 dr. of grass afford of nutritive matter -	60 gr.						
The produce of the space, ditto - - -	150		3403	2 =	212	11	2
The weight of nutritive matter, which is lost by leaving the crop till the seed be ripe, exceeds one-fourth part of its value, and is - - - - - -					70	14	6

The proportional value which the grass, at the time of flowering, bears to that at the time the seed is ripe, is as 4 to 3.

The produce of latter-math is,

Grass, 3 oz. The produce per acre - - - - -			32670	0 =	2041	14	0
64 dr. of grass afford of nutritive matter	1 dr.		510	7 =	31	14	7

The above facts shew this grass to be one of the inferior species, with respect to produce, nutritive qualities, and reproductive powers. In Germany it grows wild on hilly grounds,

Melica ciliata.

Ciliated Melic-grass.

downs, and by the margin of woods; it may be ranked with the Glaucous, and Sea-green Meadow grasses *(Poa glauca et Poa cæsia)*. Among the grasses not natives of Great Britain, that have been brought under observation in the course of these details, two species only have offered proofs of fitness for the purpose of permanent pasture, on soils of the best quality: nerved meadow-grass *(Poa nervata)*, and fertile meadow-grass *(Poa fertilis)*; the superior merits of these, over many other grasses, have already been considered.

It flowers in the third week of June, and the seed is ripe about the second week of July.

Vicia sepium. Bush Vetch.

Specific character: Legumes pedicelled, mostly four together, erect, smooth; leaflets ovate, obtuse, the outer ones smaller.

Obs.—Stems climbing by tendrils, from one to two feet high, according to its place of growth, grooved. Leaves many paired, terminated by a branching tendril. Leaflets ovate, obtuse, sometimes emarginate, somewhat hairy, the outer ones gradually smaller. Flowers commonly in fours, on very short pedicels, all directed one way, dark blue, purple. Legume or pod, nearly erect, brown, dotted, smooth. Seeds globular, even. Flo. Brit.; E. Bot. 1515; Flo. Dan. 699; Wither. Arr. ed. 4, p. 623; Bath Soc. Pap. v. ii. p. 49.

Native of Britain. Root Perennial.

Experiments.—The produce on the sixteenth of April from a brown sandy loam, with manure, is

	dr.	qr.	oz.		lbs.		
Grass, 8 oz. The produce per acre - - - -			87120	0 =	5445	0	0
64 dr. of grass afford of nutritive matter -	3	0					
The produce of the space, ditto - -	6	0	4083	12 =	255	3	12
At the time of flowering, the produce is,							
Grass, 26 oz. The produce per acre - - - - - -			283140	0 =	17696	4	0
80 dr. of grass weigh, when dry - -	20	0					
The produce of the space, ditto - -	104	0	70785	0 =	4424	4	0
The weight lost by the produce of one acre in drying - - - -			13272	0	0		
64 dr. of grass afford of nutritive matter -	3	2					
The produce of the space, ditto - - -	22	3	15484	3 =	967	12	3
At the time the seed is ripe, the produce is,							
Grass, 30 oz. The produce per acre - - - - -			326700	0 =	20418	12	0
80 dr. of grass weigh, when dry - -	22	0					
The produce of the space, ditto - -	132	0	89842	8 =	5615	2	8
The weight lost by the produce of one acre in drying - - - -			14803	9	8		
64 dr. of grass afford of nutritive matter -	4	0					
The produce of the space, ditto - -	30	0	20418	12 =	1276	2	12
The weight of nutritive matter, in which the crop at the time the seed is ripe exceeds that at the time of flowering, is - - - - - - - -					308	6	9
The produce of latter-math is,							
Grass, 10 oz. The produce per acre - - - - -			108900	0 =	6806	4	0
64 dr. of grass afford of nutritive matter -	3	1	5530	1 =	345	10	1

Vicia sæpium.
Bush Vetch.

In the Memoirs of the Bath Agricultural Society, the Rev. G. Swayne informs us, that the Bush Vetch "shoots earlier in the spring than any other plant eaten by cattle; vegetates late in the autumn, and continues green all winter. But it is difficult to collect the seeds, as the pods burst and scatter them about, and, moreover, hardly a third part of them will vegetate, being made the nidus of an insect. A patch sown in drills in a garden, was cut five times in the course of the second year, and produced at the rate of twenty-four tons on an acre, of green food; and when dry, would weigh near four tons and a half." The nutritive matter of this vetch, consists almost entirely of mucilage and sugar; the bitter extractive principle, which exists in the nutritive matter of the leaves of all grasses, is here in a less proportion. The produce in these experiments is less than that obtained by Mr. Swayne, but the difference is to be accounted for from the different soils employed. The plant attains to a considerable height when connected with bushes, and evidently prefers shady situations. But the produce, as shewn above, on a middling soil, in an exposed situation, is very considerable; and it maintains its place when once in possession of the soil. Horses and oxen are very fond of it; I have observed them eat it closer to the ground than they did the surrounding herbage of Cock's-foot, Tall Oat-like Soft-grass, Ray-grass, and Cow Clover. Its produce is very inferior when cultivated on a clayey soil, for which it appears unfit.

It comes into flower about the middle of May, and the seed is ripe about the middle and end of June.

Lolium perenne. Rye-grass, Ray-grass, Perennial Rye-grass.

Specific character: Spike awnless; calyx shorter than the spiket.

Obs.—The varieties of this species are very numerous; as the slender Rye-grass, (var. *tenue*); the compound, or broad-spiked Rye-grass, (var. *compositum*); Pacey's Ray-grass, (var. *ramosum*); and varieties of these, according to the age of the plant, and the soil it grows in. The first variety, (*tenue*), is common to dry pasture land that has been impoverished and worn out by injudicious cropping; it is distinguished from the other varieties of Rye-grass by its perfectly upright spike, which is slender, and the spikets small, and distant from each other, consisting of 3-5 flowers; the root-leaves are very narrow, and few in number; the culms are almost naked, or destitute of leaves. The second variety, (*compositum*), grows in a richer soil, or in soils that have been long under grass, and is there, for the most part, confined to beaten parts, as the cart-ways, and sides of paths. It is distinguished by its short and broad spike, crowded with spikets towards the top; spikets consisting of from seven to nine florets, of a green or purplish colour; the culm is never upright, but ascending, and almost covered with the sheaths of the leaves, which are numerous. The third variety, (*ramosum*), is more common in rich meadow land than in any other soil; the spike is nearly upright, spikets shorter, glumes more pointed, and the stem furnished with long leaves; the root-leaves are numerous, and larger in every respect than any of the preceding. I believe this to be the improved, or Pacey's Rye-grass, as it is the most valuable of any of the varieties of Rye-grass; otherwise, I have been furnished with each of these varieties from different persons, for the true improved Pacey's Ray-grass. The

Lolium perenne.
Rye-grass. Ray-grass.

variety which I here consider the true or best sort, is sold by Messrs. Gibbs and Co. under that name. All these have a strong tendency to vary in their form, when sown on different soils. The annual species of Rye-grass are common only to land under cultivation: they will be found under the head of Plants adapted for the Alternate Husbandry.

Root perennial, fibrous.

Experiments.—On the 16th of April, the produce from a rich brown loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 6 oz. The produce per acre - - - -			65340	0 =	4083	12	0
64 dr. of grass afford of nutritive matter -	2	1	2297	0 =	143	9	0
At the time of flowering, the produce is,							
Grass, 11 oz. 8 dr. The produce per acre - - -			125235	0 =	7827	3	0
80 dr. of grass weigh, when dry - -	34	0					
The produce of the space, ditto - -	78	$0\frac{4}{5}$	53224	14 =	3389	0	14
The weight lost by the produce of one acre in drying - - - -			4438	2	2		
64 dr. of grass afford of nutritive matter -	2	2					
The produce of the space, ditto - -	7	$0\frac{3}{4}$	4891	15 =	305	11	15
At the time the seed is ripe, the produce is,							
Grass, 22 oz. The produce per acre - - - -			239580	0 =	14973	12	0
80 dr. of grass weigh, when dry - -	24	0					
The produce of the space, ditto - -	105	$2\frac{2}{5}$	71874	0 =	4492	2	0
The weight lost by the produce of one acre in drying - - - -			10481	10	0		
64 dr. of grass afford of nutritive matter -	2	3					
The produce of the space, ditto - -	15	$0\frac{1}{5}$	10294	7 =	643	6	7
The weight lost by the produce of one acre in drying, is,							
Grass, 5 oz. The produce per acre - - - -			54450	0 =	3403	2	0
64 dr. of grass afford of nutritive matter -	1	0	850	12 =	53	2	12
The weight of nutritive matter, in which the produce of one acre, at the time the seed is ripe, exceeds that at the time of flowering, is - - - - -			337	10	8		

The proportional value which the grass, at the time of flowering, bears to that at the time the seed is ripe, is as 11 to 10; and to the grass of the latter-math, as 5 to 2.

There has often been occasion to observe, that though grass, when left till the seed be ripe, may afford a greater quantity of nutritive matter, nevertheless the value of the latter-math which is lost by this means, is often greater than the extra quantity of nutritive matter thus obtained; add to this, the impoverishing effects of the plants on the soil by the process of ripening the seed, and the less palatable nature of the hay. The plants of grass are likewise much weakened by the production of seed, for in all the experiments I have made, the produce of latter-math proved always less, in many instances one-half less in a given time after the seed crop, than after the crop taken at the time of flowering; I never could perceive, however, that the bad effects extended in any degree to the next following season, the weight of produce being then as frequently superior, as equal or less.

Rye-grass appears to have been cultivated previous to the year 1677*; besides which, Red Clover, Sainfoin, Spurrey, Trefoil, and Nonsuch, were the only plants then cultivated as grasses, or termed such. And it is only of late years that any other species of the natural grasses has been tried as a substitute for it, in forming artificial pastures—as cat's-tail grass, (*Phleum*

* See the first edition of Woldridge's Husbandry: my copy is the third edition, dated 1681.

pratense); cock's-foot grass, *(Dactylus glomerata);* and fox-tail grass, *(Alopecurus pratensis).* The Cat's-tail grass appears to have been made trial of before either of the other two, not more than fifty years ago, by Mr. Rocque, a farmer at Walham-green, near London. The seed of the Cock's-foot grass was introduced about the same time from Virginia, by the Society of Arts, &c. but no trial was made of it till several years afterwards: it was then called Orchard-grass*; and it is but lately that the Fox-tail grass has been tried on an extensive scale, the merits of which seem to have been first accurately pointed out by the late excellent Mr. Curtis, in his several works on grasses.

There has been much difference of opinion respecting the merits and comparative value of Rye-grass. It produces an abundance of seed, which is easily collected, and readily vegetates on most kinds of soil under circumstances of different management; it soon arrives at perfection, and produces in its first years of growth a good supply of early herbage, which is much liked by cattle. These merits have, no doubt, upheld it till the present day in practice, and will probably, for some time to come, continue it a favourite grass with many Farmers. But the lattermath of Rye-grass is very inconsiderable, and the plant impoverishes the soil in a high degree, if the culms, which are invariably left untouched by cattle, are not cut before the seed advances towards perfection. When this is neglected, the field, after Midsummer, exhibits only a brown surface of withered straws.

Let the produce and nutritive powers of Rye-grass be compared with those of the Cock's-foot grass, and it will be found inferior in the proportion nearly of 5 to 18; and also inferior to the Meadow Fox-tail, in the proportion of 5 to 12; and inferior to the Meadow Fescue, in the proportion of 5 to 17. In these comparisons, from which the above proportions arose, it was necessary to omit the seed crops, for the truth of comparison.

But as the seed of the Fox-tail is often defective, and the plants of the fescue *(Festuca pratensis)* do not arrive at perfection so soon as those of Rye-grass; their superiority, as above, over Rye-grass, is somewhat lessened with respect to their value as alternate husbandry grasses; for permanent pasture, however, the above proportional values will be found true, as Rye-grass is but a short-lived plant, seldom continuing more than six years in possession of the soil, but is continued, by its property of ripening an abundance of seed, which is but little molested by birds, and suffered to fall and vegetate among the root-leaves of the permanent pasture grasses. But Cock's-foot grass perfects an abundance of seed, and the plants arrive at a productive state as soon as those of Rye-grass; hence its superiority over Rye-grass, as above, is equally great for permanent pasture, and the alternate husbandry; which is not so precisely the case with the Fox-tail grass, and Meadow Fescue. One peck of Ray-grass, with fourteen of Clover, per acre, is generally considered sufficient for sowing artificial pastures.

Rye-grass, when not more than three years old, flowers in the second week of June, and ripens the seed in about twenty-five days after: as the plants become older, they flower much later, sometimes so late as the beginning of August.

* Annual Register for 1765, p. 141, et seq.

Trifolium medium. Red Perennial Clover, Cow-grass.

Specific character: Spikes loose, stems flexuose, branched; corollas nearly equal; stipules sublate, linear. E. Bot. t. 190; Wither. Arr.

Obs.—The common Broad-leaved Red Clover is distinguished from the present plant, by the spike which is supported on a foot-stalk; the spike, or flowering head of the Perennial Clover or Marl-grass, being without any foot-stalk, but sitting on the base of a leaf. The stem of the perennial sort is more constantly zig-zag; and the root is slightly creeping. The spike is evidently less compact than that of the Broad-leaved, or Biennial Red Clover. The leaves are also smoother, and longer. There are three varieties of the broad-leaved clover *(Trifolium pratense)*, mentioned by botanical writers, one of which is said to be perennial, and the true Marl or Cow-grass; but all the seeds and plants I have had for this (except that from Messrs. Gibbs and Co. which proved to be the present plant) have turned out only two-year-lived plants, or never exceeding three, though cultivated on various soils; and I never could find a perennial variety which answered to the description of the *Trifolium pratense*, though I have searched for it in every soil where opportunity offered. The plant upon which the following experiments were made, was taken from a rich ancient pasture, which was so closely cropped at the time, that the plant was only three inches high, though in flower. This plant is also frequent on cold tenacious clayey soils, where it is of smaller stature, more woody, and darker coloured; but when transplanted to a richer soil, its appearance is much altered. The distinctions of the perennial and the biennial root, are the most certain, and of the most importance to the Agriculturist, in choosing between two plants of nearly equal value for the purpose of permanent pasture. To avoid any chance of mistake, therefore, I here present a specimen of the Perennial Red Clover, which I have brought from a rich ancient pasture that had never been under the plough, according to the oldest recollection.

Experiments.—At the time of flowering, the produce from a rich black loam, is,

	dr.	qr.		oz.		lbs.		
Grass, 30 oz. The produce per acre - - - -				326700	0 =	20418	12	0
80 dr. of grass weigh, when dry - -	25	0						
The produce of the space, ditto - -	150	0	- -	102093	12 =	6380	13	12
The weight lost by the produce of one acre in drying - - - - - -						14037	14	4
64 dr. of grass afford of nutritive matter -	2	1						
The produce of the space, ditto - -	16	3½	- -	11485	8 =	717	13	8
The produce of latter-math at two different cuttings, is								
Grass, 28 oz. The produce per acre - - - - -				304920	0 =	19057	8	0
64 dr. of grass afford of nutritive matter -	2	1						
The produce of the space, ditto - -	15	3	- - -	10719	13 =	669	15	13

The weight of nutritive matter contained in the latter-math herbage, is equal to that afforded by the flowering herbage. The plant, as it passes this stage of growth, becomes woody, particularly at the bottom of the stalks. It pushes forth flowering stems during all the summer and autumn, if never suffered to perfect its seed. It withstands the effects of severe dry weather better than most pasture plants, continuing to flower, even when the surrounding herbage is burnt up on strong loamy soils. The white clover, *(Trifolium repens)*, and the hop clover,

Trifolium medium.
Red Perennial Clover.

(Trifolium procumbens), are, at least as far as my observations have extended, the only plants beside, that retain verdure and powers of growth under such circumstances. There were favourable opportunities during the long-continued season of dry weather in this year, (1815), to observe the powers of different grasses and plants to resist the effects of drought: there were no plants on ancient pasture land, on lighter soils, or on clays, that appeared so little affected by it as those I have mentioned. The common quaking-grass, *(Briza media)*, was to all appearance completely dried up, while on a sandy soil, a rich black loam, and a strong clayey soil, the fine bent-grass, *(Agrostis capillaris)*, and the different varieties of the stoloniferous Bent-grass, or Fiorin, were, with respect to foliage, in the same state as the Quaking-grass. This property, therefore, gives additional value to the Perennial Red Clover.

On a comparison of the produce and nutritive qualities of the broad-leaved clover, *(Trifolium pratense)*, with those of the above, the Broad-leaved Clover is found to be greatly superior.

The broad-leaved cultivated clover, *(Trifolium pratense)*,

	lbs.	lbs. per Acre in one Year.
At the time of flowering, affords of nutritive matter from the produce of one acre of a clayey loam - - - - - - - - - - - -	1861	2791
From the produce of latter-math, taken at two different times - - - - - -	930	

The perennial red clover, *(Trifolium medium)*, as above,

Affords of nutritive matter, from the produce at the time of flowering - - - -	717
From the produce of latter-math, at two different cuttings - - - - -	670
The weight of nutritive matter, in which the produce of one acre of the *Trifolium pratense*, (broad-leaved cultivated clover), exceeds that of the Perennial Red Clover, is - -	1404

In regard to produce, therefore, the Biennial-rooted Clover is superior to the Perennial, in the proportion nearly of 2 to 1. As a plant for the alternate husbandry, the Broad-leaved cultivated Clover will evidently be preferred; but for permanent pasture, the cow clover, *(Trifolium medium)*, must of necessity have the preference. The quantity of nutritive matter contained in the herbage of the Broad-leaved Clover is somewhat greater than in the herbage of the Perennial Red Clover, proportionally, according to my experiments, as 10 to 9. The constituent parts of the nutritive matters of the plants are nearly alike, only the Broad-leaved Clover contains nearly three per cent. more of the bitter extractive and saline matters than are contained in an equal weight of the Perennial Red Clover. This species likewise contains much less superfluous moisture than the former, and is in consequence more quickly and safely converted into hay; for it is evident the difficulty of making good hay, is in direct proportion to the quantity of superfluous moisture any herbage may contain. The comparative fitness of the different grasses for making into hay, which have already come under observation, with those that follow, may therefore be ascertained by the statements which are given of the loss of weight which each species sustains in drying at the different stages of growth.

The value of the Red Perennial Clover has been disputed; but it seems probable that any doubt as to its merits, may have arisen from using it instead of the *Trifolium pratense*, (biennial red clover), in the alternate husbandry, for which it seems unfit, or at least greatly inferior to that species. But for permanent pasture, its value is undoubtedly considerable, and it

will be found as an essential constituent of every mixture of grasses adopted for that purpose*.

It flowers about the beginning of July, and the general crop of seed is ripe about the beginning of September.

Trifolium repens. White Clover, White Trefoil, Dutch Clover.

Native of Britain. Root perennial. Curt. Lond. 193; Flo. Dan. 990; E. Bot. 1769.

This species of Clover is so familiar to every Agriculturist, that a specific description of it in a work of this nature, may be unnecessary.

The value of White Clover to the Farmer is well known. It is common in most, or rather, it is present in every kind of pasture land in Britain. From the circumstance of growing spontaneously in almost every kind of soil, few plants vary so much in size: in very dry and poor sandy soils, it is often so small, and grows so flat among the lower leaves of the herbage, that it is not perceptible unless a turf is cut, and carefully examined by dividing it; hence, on breaking up, and manuring such soils, or simply manuring by top-dressing, a spontaneous crop of White Clover appears where it was never observed before, and without any supply of seed: this has led to strange conclusions respecting the propagation of plants.

The central root of White Clover penetrates to a considerable depth in the soil, and the plant is thereby better prepared to resist the bad effects of severe dry weather, particularly on sandy soils. The branches that trail on the surface, send down fibrous roots from the joints, which penetrate but a little way into the ground: hence it is, that the White Clover maintains itself in soils of opposite natures; for if the surface be too dry to afford nourishment to the branches, the principal root preserves it; and when the tenacity and retentiveness of the soil in a wet winter, is great enough to rot the tap-root, the fibres of the runners preserve the plant in safety. From this habit of growth, top-dressings and a frequent use of the roller encourage the growth of this plant in an extraordinary degree. White clover, when cultivated by itself, is far from forming so good a pasture as when combined with the natural grasses, and I have witnessed the dangerous effects of pure Clover pasture, on sheep, by inducing disease; and at the same time, the superior value of it in pastures containing a due admixture of the natural grasses: among many instances of this sort, one is selected and mentioned in the introduction to these details of experiments.

On a comparison of the nutritive matter afforded from equal weights of the White and Red Clovers, it appears that the White Clover is inferior.

* Hares and rabbits are very fond of this clover when cultivated on a rich soil. Some plants of it were brought from a tenacious cold clayey soil, on the borders of a wood, and planted in the grass-garden on a rich loam, for the purpose of comparing it with the same species collected in a rich ancient pasture. I observed at the time I took up the plants near the wood, that none of them seemed to have been touched by these animals, which were the only animals that had access to the herbage. But they preferred it throughout the whole season in the grass-garden, to almost every other grass or clover, and completely broke through a temporary fence, made specially for its protection, and disappointed my expectation in the results of some particular experiments.

	dr.	qr.
The biennial red clover *(Trifolium pratense)*, affords of nutritive matter -	2	2
The perennial red clover *(Trifolium medium)*, affords of ditto - - -	2	1
The white, or Dutch clover *(Trifolium repens)*, affords of ditto - -	2	0
The Brown five-leaved variety of White Clover, affords of ditto - - -	2	2

The White Clover is therefore inferior to the Biennial Broad-leaved Red Clover, in the proportion of 5 to 4; and inferior to the Red Perennial Clover, in the proportion of 10 to 9. The Brown variety of White Clover is equal to the Biennial Red Clover, in the quantity of nutritive matter it contains, but with respect to the quantity of herbage, it is greatly inferior to the White variety, or Dutch Clover.

Sir Humphry Davy has shewn, that the nutritive matters of the Clovers contain a greater proportion of bitter extractive and saline matters, than the proper grasses; and that when pure clover hay is to be mixed as fodder, it should be with summer hay, rather than after-math hay*.

Agrostis stolonifera (var. 1, *latifolia*). Larger-leaved Creeping Bent, Fiorin.

Specific character: Panicle loose at the time of flowering, contracted afterwards; florets large, numerous; calyx husks acuminate, outer serulated from the keel upwards, inner only slightly towards the top.

Obs.—This variety of Creeping Bent-grass, being confined to the richest natural pastures, at least as far as my observations have extended, I have introduced it in this place; the specimens and details of experiments made on the other varieties, which are now to be mentioned, will be found in another part of this Work.

Var. 2, Smaller-leaved Creeping Bent (see *Agrostis stolonifera*, var. *angustifolia*), is distinguished from the above, by its panicle, which is densely crowded with florets. Smaller, of a whitish colour, which distinguishes it at first sight from the large spreading dingy purple panicle of the above; the leaves are longer and broader, pointing more direct from the stem: the joints are more distant in this variety, and distinguished from those of every other variety of Fiorin, by the dull purple or brownish colour, which seems to unite them with the stem: in the *angustifolia*, the colour is white or grey. This variety I believe to be the *Agrostis stolonifera* of the English Botany, 1532.—Var. 3, Awned Creeping Bent-grass (see *Agrostis stolonifera*, var. *aristata*) is distinguished from the first variety by its larger valve of the blossom having an awn twice its length, while the same valve in the true Fiorin (var. 1.), has only the rudiment of an awn fixed below the apex, and which can only be distinctly seen by the aid of a glass; the panicle is also smaller; the colour of that part of the stem nearest to the joint, is reddish; the joints much less swoln.—Var. 4, Wood Creeping Bent-grass, (see *Agrostis stolonifera*, var. *nemoralis*), is more like the first variety than any of the others; but the panicle is more wide-spreading, the branches rougher, the florets more pointed, smoother, the leaves narrower, and lying more flat on the ground; the creeping stems, or runners, are more slender, and lie quite flat on the ground, joints smaller, and nearly colourless. The Marsh Creeping Bent-grass may be justly considered var. 5, (see

* Agricultural Chemistry.

Agrostis stolonifera, latifolia.

G g

Larger-leaved Creeping Bent. Fiorin.

Agrostis palustris): it approaches nearest to var. 2, *(angustifolia),* but the panicle is spear-shaped, loose when in flower, and contracted so much when in seed, as to resemble a spike, and is of a whitish grey colour: it is essentially distinguished from the others by the larger valve of the blossom being furnished with a minute awn, which rises a little above its middle, and reaches to the top of the valve: the awn is straight, and pressed close to the back of the valve.

The above characters of distinction, and the specimens which are afterwards given to illustrate them, were taken from plants raised from seed on the same, and on different soils, that the plants were found naturally growing on; the characters of the wild plants were compared with those of the cultivated ones, and what remained constant after these changes of circumstances, are the above. It is easy to conceive the change that takes place in the general appearance of a plant when brought out of a wet ditch, and cultivated on a dry exposed soil, or from under the shade of trees on a poor sand, and planted out on a rich loam with full exposure to sun and air. Characters, therefore, that change with these changes of circumstances, tend more to perplex than enlighten, and may therefore be better omitted.

Experiments.—At the time of flowering, the produce from an active peat soil, is,

	dr.	qr.	oz.		lbs.		
Grass, 26 oz. The produce per acre - - - -			283140	0 =	17696	4	0
80 dr. of grass weigh, when dry - -	35	0	- -	123873	12 =	7742	1 12
The produce of the space, ditto - -	182	0					
The weight lost by the produce of one acre in drying - - - -					9954	2	4
64 dr. of grass afford of nutritive matter -	3	2	- -	15484	3 =	967	12 3
The produce of the space, ditto -	22	3					
At the time the seed is ripe, the produce is,							
Grass, 28 oz. The produce per acre - - - - - -			304920	0 =	19057	8	0
80 dr. of grass weigh, when dry -	36	0	- -	137214	0 =	8575	14 0
The produce of the space, ditto - -	201	$2\frac{2}{5}$					
The weight lost by the produce of one acre in drying - - - -					10481	10	0
64 dr. of grass afford of nutritive matter -	3	2	- -	16675	5 =	1042	3 5
The produce of the space, ditto - -	24	2					
The weight of nutritive matter which is lost by taking the crop at the time of flowering, exceeds one-fourteenth part of its value, and is - - - - - -					74	7	2
The produce of latter-math, is,							
Grass, 4 oz. The produce per acre - - - -			43560	0 =	2722	8	0
64 dr. of grass afford of nutritive matter -	50 gr.		- - -	1134	6 =	70	14 6
The space, when left uncut till the month of December, afforded of							
Grass, 30 oz. The produce per acre - - - - - -			326700	0 =	20418	12	0
	dr.	qr.					
64 dr. of grass afford of nutritive matter -	4	2	- - -	22971	1 =	1435	11 1
The produce of the space, ditto - -	33	3					
The weight of nutritive matter in which the crop taken in December, exceeds that taken at the time of flowering, in the proportion of 16 to 11, is - - - - -					467	14	14

The Rev. Dr. William Richardson has introduced this variety of the *Agrostis stolonifera* to the agricultural world, under the name of Fiorin, and has shewn its merits and properties, deduced from his own experiments, in a variety of publications on the subject, to which the reader is referred. It is greatly superior, in point of produce and nutritive powers, to the other varie-

ties of the *Agrostis stolonifera*, which have been enumerated; this will be manifest, on referring to the details of experiments made upon them, as given under the head of grasses natural to moist soils.

On comparing the specimens of these different varieties, their resemblance to each other is so great, that they may be easily mistaken for each other, without a close inspection, and some knowledge of botany to assist it. It was before observed, that this variety, (larger creeping Bent, or Fiorin), appears to be confined to rich ancient pasture land, as its natural place of growth, and the other varieties to various soils and situations; and that when taken from these different soils, and cultivated together under the same circumstances, they retain the discriminating characters before mentioned.

On damp clayey soils the second variety is the most common grass. To moors and bog soils the third variety is chiefly, or (at least according to my observations), altogether confined. To light sandy soils, particularly when more or less shaded, the fourth variety is peculiar; and the fifth variety is seldom found but in the bottom of ditches, or by the sides of rivulets. The first variety being therefore scarce, and the others very common, there is little room for surprise at the contradictory results of experiments that have been made on one or other of these inferior varieties, by Gentlemen equally eminent for agricultural knowledge, under the conviction of their being one and the same grass as recommended by Dr. Richardson under the name of Fiorin; whereas, though they agree in the general habit of Dr. Richardson's variety, and indeed in every respect, except in the characters before described, their inferiority in every agricultural merit is so great, as to justify the opprobrious epithets that have been bestowed upon them by those who, from the above causes, have differed from Dr. Richardson's statements of the merits of the first variety, or Fiorin, and prevented that justice being done to the discovery which it may have deserved.

The above details will assist the Farmer in deciding on the comparative merits of this grass, as a constituent of a mixture of grasses for permanent pasture; from which it will doubtless appear worthy of attention, but its value not so great as has been supposed, if its habits or manner of growth be impartially taken into the account, when compared with the produce and nutritive powers of other grasses.

This grass, when cultivated by itself, cannot be profitably depastured, on account, principally, of its peculiar manner of growth, which has been compared to that of strawberries. It sends out runners or stolones, which strike root at the joints; the feet of cattle mixing part of the soil with these, render the most valuable part of the plant unfit for food. In its combined state in ancient pastures, this objection is lost, as the root-leaves and consolidated turf of the various grasses, prevent completely such an effect from the feet of the cattle, which will be evident on a few moments' examination of a close-eaten turf of such pastures as now described. In this state it is much less productive than when cultivated singly, as the fibrous roots of the stolones derive their only nourishment from the moisture secreted among the root-leaves of the other grasses.

The chief advantage of this grass in permanent pasture, is its late growth. It remains in a degree inactive, till other grasses have attained to perfection, and when their productive powers become exhausted, those of Fiorin and its varieties begin; and it will be found, on inspection,

that the latest mouthful of herbage, and sometimes the earliest in those pastures, is principally afforded by this grass.

There has been much prejudice existing against the different species of Agrostis in general; but let the proprietor of a rich ancient pasture, divest a part of it of this grass entirely, and the value of the plant will be demonstrated in the comparative loss of late and early herbage. In these pastures, late in the autumn, I have observed the stolones extend to a considerable length, and left untouched by cattle: in the spring, however, they were generally eaten, and the protection they had afforded to the under grasses, was evident in the superior early growth of the herbage where the stolones had most extended; after this, the Creeping Bent was hardly to be recognized, till the other grasses had again exhausted themselves towards the end of the autumn. The plant, in this state of combination, takes but little from the soil.

In comparing the produce and nutritive powers of different grasses, to arrive at a knowledge of their relative value, it is absolutely necessary, for the truth of comparison, that the produce of one whole season be taken, and not one crop singly, except in instances where the produce consists but of one crop only. Accordingly, the produce of Fiorin may be compared with that of the cock's-foot grass, *(Dactylus glomerata)*, meadow fescue, *(Festuca pratensis)*, and the meadow-foxtail, *(Alopecurus pratensis)*, when it will appear inferior to the two former species, and superior to the latter. On referring to former details it appears, that

	lbs. per Acre in one Year.	
The *Agrostis stolonifera*, var. *latifolia*, larger creeping bent,		
From the produce of one season, taken in December, affords of nutritive matter - - -		1435
The *Dactylis glomerata*, cock's-foot grass,		
From the produce of early herbage in the spring, affords of nutritive matter - -	358	1728
From the produce at the time of flowering, affords of nutritive matter - - -	1089	
From the produce of latter-math, affords of nutritive matter - - - - -	281	
The *Festuca pratensis*, meadow fescue,		
From the produce of early herbage in the spring, affords of nutritive matter - -	382	1719
From the produce at the time of flowering, affords of nutritive matter - - - -	957	
From the produce of latter-math, affords of nutritive matter - - - - -	380	
The *Alopecurus pratensis*, meadow-foxtail,		
From the produce of early herbage, affords of nutritive matter - - - -	483	1216
From the produce at the time of flowering, affords of nutritive matter - - - -	478	
From the produce of latter-math, affords of nutritive matter - - - - -	255	

The Cock's-foot grass, under the circumstances described, is therefore superior to the larger variety of the Creeping Bent, in the proportion, nearly, of 11 to 9.

The meadow fescue, *(Festuca pratensis)*, is also superior to Fiorin, in nearly the like proportion as Cock's-foot.

The meadow foxtail-grass, *(Alopecurus pratensis)*, is inferior to Fiorin, in the proportion, nearly, of 7 to 6.

Though the quantity of nutritive matter afforded by a grass in one whole season, is the chief property by which its comparative value can be determined, yet the particular season or seasons in which it is produced, the nature of the soil on which it can be cultivated to most advantage, and the superior facilities its peculiar habits of growth afford for its propagation, as also for reaping its produce, are points which must necessarily be taken into the account by the Agriculturist,

according as they are influenced by local circumstances; such as the nature of the soil, and situation of his farm.

When cultivated separately for the purpose of green food or hay*, Fiorin requires to be kept perfectly clear of weeds, its couchant habit of growth affording great encouragement for the health of upright-growing plants—under this circumstance weeds. The numerous fibrous roots that issue from the joints of the trailing shoots or stolones, exhaust the surface of the soil in a considerable degree; top-dressings with manure are, therefore, absolutely necessary to keep up the superior productive powers of Fiorin. Without these points being sufficiently attended to in the cultivation of this grass, disappointment will be the result.

The merits of this variety of the Creeping Bent for the purposes of permanent pasture, have already been mentioned, and that its productive powers, when in combination with other grasses, are much less than are shewn in the above details; from which it will appear to be a necessary constituent of a mixture of grasses, to form, in all particulars, the most valuable permanent pasture, though in a less proportion than most other species admitted to form such a mixture.

It perfects a sufficiency of seed which readily vegetates; and the plants, when properly encouraged by top-dressings, I have found invariably to arrive soon at perfection. When the runners or stolones are used instead of seed, the ground is much sooner clothed with the grass: when meant as a crop by itself, the planting of the shoots or stolones appears to be the best mode; but when intended as part of a mixture of other grasses, the seed will be found by experience to be the most proper.

It flowers about the second and third weeks of July, and the seed is ripe about the second and third weeks of August.

The grasses, and other plants, that have now been submitted to the better judgment of the reader, comprehend all the grasses and plants which the Author could ever find in the *body* of the richest natural pastures, examined every month of the year, and oftener; some other species, it is true, were sometimes found on particular spots, but could not, from their local situation, be considered as naturally belonging to such: they will be mentioned hereafter.

To those who may have perused and bestowed some consideration on the foregoing details, it may be unnecessary to observe, that the facts and observations there brought forward, offer sufficient proofs, that it is not from one or two, but from a variety of different species of grasses, that the Agriculturist can hope to form in the shortest space of time, a sward equal if not superior to that of the richest natural pastures.

Hastiness in generalizing from a few facts only, in things pertaining to the properties and cultivation of plants, has often led to error; it seldom benefits the cause it meant to advance: every one is told this plant, or that mode of cultivation, will best suit his purpose; most make trial, and from the want of that caution which generalization in the outset destroys, the majority fails; this leads to a difference of opinion on one side; and on the other, to a contempt of that which, when taken in its limited sense, would have produced every advantage the object was capable of affording.

* The mode of converting Fiorin into hay, during the winter months, is amply detailed in Dr. Richardson's publications on Fiorin. Full information will there be likewise found, on the productive powers, uses, modes of cultivation, &c. &c. of this grass, deduced from the Doctor's own experiments.

The hope of discovering, and the discovery of a single grass, or mode of cultivation superior to every other for all the purposes of the Agriculturist, under every circumstance, would surely be as rational, and when effected, as great, as those of the Philosopher's stone, and the universal specific.

From a careful perusal of the foregoing series of facts and observations, the following conclusion will appear just: that the failures in attempts to renew the original valuable sward on rich ancient pasture lands, rise not from the length of time that the plants require to arrive at perfection from seed, nor from the injury the land sustains from a course of grain crops; but evidently from the neglect of employing the seeds of those grasses which are natural to the soil, and that constituted the produce of the valuable pasture. What those grasses are, and their comparative merits and value, the specimens, and the details of experiments, will in a great measure have shewn.

It appears most unaccountable, that, at this day, when the different branches of practical agriculture seem to be so well understood, it should be asserted, and without contradiction too, that it is of no importance what kinds of grasses are sown upon lands for the purposes of permanent pasture, as Nature itself, in the course of time, will produce those kinds of grasses best adapted to the soil, and which only remain permanent. Now, as the whole art of cultivating plants is nothing more than *assisting* Nature in the process of the growth of vegetables, surely the above doctrine can amount to nothing more than the confession of an utter deficiency in the knowledge of the art of assisting Nature in the process of clothing the soil with its natural perennial grasses; or, that instead of three or four years, in the course of which, by the kind assistance of art, the valuable sward may be renewed, it is better to leave it to the slow unassisted efforts of Nature, to be renewed in eight, ten, or twenty years.

The superiority of ancient natural pastures, over those formed artificially with Rye-grass and Clover, was before alluded to. It will be found principally to arise from the variety of different habits and properties which exist in a numerous combination of different species of grass. From the beginning of spring, till winter, there is not a month that is not the peculiar season in which one or more grasses attain to the greatest degree of perfection. Some grasses there are, that withstand the injurious effects of long-continued dry weather better than others, and *vice versa*. Hence, the comparatively never-failing supply of nutritive herbage obtained from natural pastures, which it is vain to look for in those artificially formed with one or two grasses only.

The chief properties which give value to a grass, are nutritive powers, produce, early growth, reproductive powers, or the property of growing rapidly after being cropped, and the facilities it offers for its propagation by seed.

If one species of grass could be discovered, that possessed all these properties in a superior degree to every other, the knowledge of distinguishing the different species of grass with certainty, that of the soils and sub-soil best adapted to their growth, and the natural habits, comparative value, and merits of the different plants, would then be more for curiosity than utility. But the results of these experiments have proved, that a combination of all the merits and pro-

perties which give value to a grass, are not to be found in a superior degree in any single grass. Indeed, if such was the case, it would seem singular that Nature, for the same purpose, finds it necessary to employ so many.

If a selection of grasses were made, with a view to early flowering only (presuming that this property constituted the chief value of a grass), it will be found, that a combination of equal proportions of sweet vernal-grass, *(Anthoxanthum odoratum)*; sweet soft-grass, *(Holcus odoratus)*; soft brome-grass, *(Bromus mollis)*; annual meadow-grass, *(Poa annua)*; and meadow fox-tail grass, *(Alopecurus pratensis)*; will produce a crop ripe to mow in the second week of May, on a soil of the best quality, these grasses being then in flower; but the produce will be found very inferior: the nutritive matter from the whole crop being only 367lbs.

A combination of the smooth-stalked meadow-grass, *(Poa pratensis)*; rough-stalked meadow-grass, *(Poa trivialis)*; hard fescue, *(Festuca duriuscula)*; common quaking-grass, *(Briza media)*; darnel-like fescue-grass, *(Festuca loliacea)*; long-awned sheep's-fescue, *(Festuca ovina hordiformis)*; and the Welsh-fescue, *(Festuca Cambrica)*; will afford a crop ready for mowing in the first week of June. The value of a crop, consisting of equal parts of these grasses, is superior to the preceding, in the proportion nearly of 4 to 3; the nutritive matter afforded by the whole crop, being 486lbs.

A combination of equal parts of the cock's-foot grass, *(Dactylis glomerata)*; meadow-fescue, *(Festuca pratensis)*; tall oat-like soft-grass, *(Holcus avenaceus)*; perennial rye-grass, *(Lolium perenne)*; upright brome, *(Bromus erectus)*; and field brome, *(Bromus arvensis)*; will produce a crop fit to mow for hay in the third week of June. The value of this crop is superior to that ripe in the first week of June, in the proportion nearly of 13 to 7; the weight of nutritive matter from the produce of one acre being 844lbs.

A combination of cat's-tail, *(Phleum pratense)*; yellow oat, *(Avena flavescens)*; crested dog's-tail, *(Cynosurus cristatus)*; woolly soft-grass, *(Holcus lanatus)*; wood meadow-grass, *(Poa nemoralis)*; meadow barley-grass, *(Hordeum pratense)*; yellow vetchling, *(Lathyrus pratensis)*; many-flowered brome-grass, *(Bromus multiflorus)*; and the lesser variety of the meadow cat's-tail, *(Phleum pratense,* var. *minus)*; will afford a crop ready for reaping in the second or third week of July. The weight of nutritive matter afforded by this crop, exceeds that of the preceding in the proportion nearly of 7 to 6; the quantity contained in the produce of one acre being about 1008lbs.

The first of these selections, though producing the earliest crop, is, nevertheless, much less valuable than any of the others; for, with the addition of the after-grass that would be produced in the extra length of time which the others require to come to maturity, the produce would still be very inferior.

A grass which produces an abundance of early foliage, and that does not put forth its flowering culms till the beginning of June, can be fed off till a late period of the spring without injury to the crop of hay, which, with a grass that pushes up its flowering culms early in the spring, cannot be practised without doing considerable injury to the hay crop. This property, therefore, of producing early foliage, and flowering late, must be more particularly valuable under circumstances where a breeding flock of sheep is kept. The grasses which are more distinguished in this respect, are the cock's-foot, *(Dactylis glomerata)*; meadow cat's-tail, *(Phleum pratense)*; nerved meadow-grass, *(Poa nervata)*; and the wood meadow-grass, *(Poa nemoralis)*.

As the leaves of grasses are the most valuable part of the plant for the purposes of grazing, a view of the quantity of nutritive matter afforded by the different species in the spring, will assist in deciding on their comparative value.

About the beginning, and middle of April, 1920 grains of the leaves of the following grasses, and other plants, afford of nutritive matter:

Meadow foxtail-grass, *(Alopecurus pratensis)*	96 gr
Tall oat-like soft-grass, *(Holcus avenaceus)*	120
Sweet-scented vernal, *(Anthoxanthum odoratum)*	52
Round-panicled cock's-foot, *(Dactylis glomerata)*	80
Perennial rye-grass, *(Lolium perenne)*	70
Tall fescue, *(Festuca elatior)*	94
Meadow fescue, *(Festuca pratensis)*	96
Crested dog's-tail, *(Cynosurus cristatus)*	88
Woolly soft-grass, *(Holcus lanatus)*	80
Creeping soft-grass, *(Holcus mollis)*	90
Meadow cat's-tail, *(Phleum pratense)*	80
Fertile meadow-grass, *(Poa fertilis)*	70
Nerved meadow-grass, *(Poa nervata)*	76
Smooth awnless brome-grass, *(Bromus inermis)*	84
Wood meadow-grass, *(Poa nemoralis)*	68
Smooth fescue, *(Festuca glabra)*	70
Long-awned sheep's fescue, *(Festuca ovina hordiformis)*	102
Darnel-like fescue, *(Festuca loliacea)*	110
Creeping bent or fiorin, *(Agrostis stolonifera Richardsonia)*	42
Wood fiorin, *(Agrostis stolonifera,* var. *sylvatica)*	62
Yellow vetchling, *(Lathyrus pratensis)*	40
Rough-stalked meadow-grass, *(Poa trivialis)*	80
Broad-leaved red clover, *(Trifolium pratense)*	80
White or Dutch clover, *(Trifolium repens)*	64
Common quaking-grass, *(Briza media)*	54
Greater bird's-foot trefoil, *(Lotus major)*	60
Long-rooted clover, *(Trifolium macrorhizum)*	76
Lucern, *(Medicago sativa)*	90
Bunias, *(Bunias orientalis)*	100
Burnet, *(Poterium sanguisorba)*	100
Cow parsnip, *(Heracleum angustifolium)*	90

Those of the indigenous grasses that afford the least nutritive matter from their spring leaves, are, the Creeping Bents, Common Quaking-grass, and the Sweet-scented Vernal. The leaves that contain the most nutritive matter are those of the Cock's-foot, Tall Oat-like Soft-grass, Meadow-fescue, Tall Fescue, Crested Dog's-tail, Meadow Cat's-tail, Darnel-like Fescue, and Rough-stalked Meadow-grass. The Perennial Rye-grass ranks with those that contain the least. Of the grasses that are not indigenous, the Long-awned or Barley-like Sheep's Fescue, the Fertile and Nerved Meadow-grasses, stand the highest.

The composition of the nutritive matter of the leaves of these grasses, differs chiefly in the proportions of starch or mucilage, and the bitter extractive and saline matters, of which they are constituted; for gluten and sugar form but a small part of their composition, compared to that in the culms or hay crop.

By boiling equal weights of the nutritive matter of the leaves of the following grasses in alcohol till the colouring matter was nearly quite discharged, and afterwards submitting the insoluble parts to the action of cold, and of boiling water, and collecting and weighing the solid matters after evaporation, the results were as follows:

100 grains of nutritive matter consisted of,

	Mucilage, or Starch.	Saccharine Matter, or Sugar.	Gluten.	Bitter Extractive and Saline Matters.
Alopecurus pratensis, (meadow-foxtail)	64	8	—	28
Festuca pratensis, (meadow-fescue)	59	20	—	20
Poa trivialis, (rough-stalked meadow-grass)	82	8	—	10
Lolium perenne, (rye-grass)	65	7	—	28
Poa nervata, (nerved meadow-grass)	83	8	—	9
Phleum pratense, (meadow cat's-tail)	74	10	—	16
Dactylis glomerata, (cock's-foot)	59	11	—	30
Avena pratensis, (meadow-oat)	80	10	—	10
Hordeum pratense, (meadow-barley)	58	8	—	34
Holcus mollis, (creeping soft-grass)	70	6	—	24 insoluble.
Agrostis stolonifera, var. *latifolia*, (broad-leaved, or fiorin)	55	5	—	40
White Clover, when in flower, according to Sir H. Davy	77	2	7	14
Red Clover, ditto	79	8	5	8
Vicia, var. *sativa*, (tares)	68	25	—	7
Trifolium officinalis, (melilot clover)	53	4	—	42
Trifolium macrorhizum, (long-rooted clover)	64	14	—	22

The bitter extractive and saline matters are considered as assisting or modifying the functions of digestion, rather than being truly nutritive parts of the compound. The experiments detailed in the Introduction, shewed that the mucilage, starch, gluten, and sugar, were retained in the body of the animal for the purposes of life, and that the bitter extractive and saline matters were voided with the woody fibre, which, combined, constituted the excrements, or those parts of the vegetable not retained in the body of the animal for the purposes of life.

Tares, and White Clover, are very succulent plants, and their fattening powers are well known; but when cultivated singly, or without admixture of any other plants, there are several instances that have come under my own observation, where they have been, in cold moist weather in the early part of the spring, productive of the diseases termed red-water, and diarrhœa or looseness; the former in sheep fed on White Clover, and the latter in cattle fed on Tares. In estimating, therefore, the comparative nutritive powers of these different proportions of vegetable principles in different grasses, or other plants, proved by experience, it appears likewise necessary to ascertain their degree of succulency, or the different proportions of water and woody fibre combined in them, as it will prove the proportion which the saline matters bear to the truly nutritive, as well as to the woody or indigestible portion of the vegetable. The statements of the loss of weight which the different grasses sustain in drying, given in the foregoing details of experiments, will assist to determine the above point in most instances. I may be permitted to illustrate this by an example:

Tares are said to be more fattening than White Clover, Cock's-foot grass, or Meadow Fescue.

3000 grains of the green herbage of		Woody or indigestible Substance.	Water.	Nutritive Matter.
Common vetch, or tares, *(Vicia,* var. *sativa)*,	consist of	557 grains.	2250 grains.	193 grains.
White clover *(Trifolium repens)*		470	2430	100
Cock's-foot grass *(Dactylis glomerata)*		1135	1740	125
Meadow fescue *(Festuca pratensis)*		1260	1590	150

Hence, 1135 grains of the woody fibre of Tares, are combined with 427 grains of saline matter;
The same quantity of White Clover, is combined with - 1014 ditto
of Cock's-foot grass, is combined with - 900 ditto
and of Meadow-fescue, is combined with - 600 ditto

The Tares and White Clover contain, therefore, nearly one-third more of water than the natural grasses, Cock's-foot and Meadow-fescue. The White Clover is remarkable for the superior quantity of extractive and saline matters it affords, in proportion to the woody or indigestible matter. The excess of water, or superfluous moisture, in Tares, and the small proportion of extractive and saline matters they contain, must render them a less valuable food in the early part of spring, when the weather is cold and moist, than in the latter part of that season, or in summer. If some of the natural grasses were combined with the Tares, it would correct this over-succulency of their nature. The annual species of grass appear to be the most proper for this purpose, merely because they soonest afford a supply of herbage from the time of sowing. The Field Brome-grass, *(Bromus arvensis)*, and Common Barley, have their nutritive matters, and the proportions of water to that of woody fibre in their substance, more opposite to those in the composition of Tares than most other grasses, and therefore promise to be the most useful.

The different species of the natural grasses differ less from each other, in the composition of their nutritive matters, than they do in general from the different species of Clover or Vetch. But in all the numerous trials I have made on the nutritive matters of the proper grasses, I could never find two species perfectly agree in the proportions of mucilage, sugar, gluten, bitter extractive, and saline matters, of which their nutritive matters consisted. To detail the results of all these processes, would probably be more tedious for the Agriculturist to read, than they were to the conductor of the experiments in the performance. What has just now been stated may be sufficient to shew, in some measure, the degree of importance that is to be attached to the properties in question, when making a selection of the most valuable grasses for permanent pasture, or indeed for any other purpose for which they are useful. The following grasses are selected, from those of which specimens have been given in the foregoing pages, as being superior to all others, in one or more of the valuable properties before mentioned: in nutritive qualities, early growth, produce, reproductive powers, permanency in the soil, and the facilities they offer for their propagation by seed.

Cock's-foot grass, *(Dactylis glomerata)*	2 bushels.
Meadow fescue, *(Festuca pratensis)*	2 ditto.
Meadow fox-tail grass, *(Alopecurus pratensis)*	2 ditto.
Rough-stalked meadow-grass, *(Poa trivialis)*	2 ditto.
Tall oat-like soft-grass, *(Holcus avenaceus)*	0½ ditto.
Meadow cat's-tail, *(Phleum pratense)*	15 lbs.
Hard, or smooth fescue, *(Festuca duriuscula, vel glabra)*	2 bushels.

Crested dog's-tail, *(Cynosurus cristatus)* - - - -	1 bushel.
Nerved meadow-grass, *(Poa nervata)* - - - - - -	0½ ditto.
Wood meadow-grass, *(Poa nemoralis)* - - - - -	1 ditto.
Narrow-leaved Meadow-grass, *(Poa angustifolia)* - - - -	0¼ ditto.
Broad-leaved creeping bent, or fiorin, *(Agrostis stolonifera*, var. *latifolia)* -	0½ ditto.
Rye-grass, *(Lolium perenne)* . - - - - -	1 ditto.
White or Dutch clover, *(Trifolium pratense)* - - - -	15 lbs.
Bush vetch, *(vicia sepium)* - - - - - -	0½ bushel.
Sweet-scented vernal-grass, *(Anthoxanthum odoratum)* - - -	0¼ ditto.
Perennial red clover, *(Trifolium medium)* - - - -	12 lbs.

The larger seeds should be mixed by themselves; and, in the same manner, the smaller seeds should be mixed together, and sown after the mixture of larger seeds, as they require much less covering.

I have sown the seeds of the same grasses in every month of the year, January excepted, and though much depends on the weather and the state of the ground, the results were always in favour of the month of August; and, next to that, the middle or latter end of May, according as the weather was dry. The seeds vegetated, and grew with most vigour under the following circumstances: when the ground had been deeply stirred, broken very fine, and made perfectly smooth and compact on the surface with a heavy roller, previous to sowing the seeds; and, at the time of sowing, the ground in a dry state, the seeds sown on this fine, dry, compact surface; the larger seeds not more than just covered, by drawing a fine rake on the level surface, and afterwards sowing the small seeds, and covering them no farther than what was effected by a repetition of the roller. The results further shewed, that, next to a coarse, inconsolidated or loose surface, the practice of deep sowing was, in the second degree, more injurious to the vegetation of the seeds, and the first progress of the plants, than any other error that could be made in the *manual* part of the process of sowing the natural grasses on a soil of good quality.

When land is to be sown down for permanent pasture, no admixture of any annual or grain crop, or Broad-leaved Clover, should be admitted with the grass-seeds. Experience will prove that they are highly injurious to the intention of speedily forming a solid productive sward; and that the profit that may accrue from a grain crop thus obtained, will be much overbalanced by the loss of grass in the two following seasons. Every plant of these annual crops occupies a place to the detriment of the expected sward; besides rendering the surface porous by the decay of their roots in the end of autumn, much mischief, likewise, is done to the sward by portions of the crops being beat down with heavy rains. The above mixture should be sown in the autumn or spring, at the rate of four and a half bushels to the acre. If sown in spring, it will be found highly useful in the following autumn, to give the surface a slight top-dressing with rotten dung or compost, in which the seeds, or roots of weeds, are not suspected, and to sow immediately after half a bushel, more or less, of the mixture of seeds, according as the sward appears to be deficient of plants; after which, (the top-dressing being previously well reduced by a slight bush-harrow), the roller should be liberally used; and *rolling* for the first two years, should never be neglected at any favourable opportunity. If the seeds are sown in autumn, the top-dressing, re-sowing, and rolling, will be found equally requisite and beneficial in the following month of May, and even if repeated in the following autumn, they will greatly forward the intention. This is imitating the process of Nature in forming pas-

tures, with this advantage, that for one seed of a valuable species of grass supplied to the soil by the slow and gradual process of Nature, in one season, a thousand are supplied in the same space of time; and thus take possession of their natural soil, without the danger and inconvenience of expelling its usurpers.

There has been some difference of opinion respecting the manner of reaping the produce of seedling grasses; whether by depasturing with sheep, or by mowing after the plants have perfected their seed. The manure supplied by sheep to the young grasses, is of great advantage; but the animals are apt to bite too close to the root, and sometimes tear up the young plants altogether. I have found on repeated trials, that cropping seedling grasses before they had produced flowers, had the effect of retarding and weakening the after-growth of the plants for that season very much. But after the period of flowering, cropping was found to strengthen, and rather encourage the growth of plants. In the same way I found, that old plants of grass, when cut very close after the first shoots of the spring made their appearance, afforded about one-third less weight of produce in the whole season, than those plants of the same species which were left uncut till the flowering culms began to appear. As the advantages of the manure of the sheep may be supplied by top-dressing, and the disadvantages resulting to the tender seedling plants from early and close cropping cannot so speedily be removed, the practice of suffering the grasses to produce flowers before they are cut, with the application of top-dressings, and the use of the roller, till the summer of the second year, appears to be far more profitable than the former practice of depasturing the seedling grasses at an earlier period than the summer of the second year. But in this, no doubt, as well as in other particular modes of management recommended for general practice in the culture of plants, local circumstances may interfere so much as often to render some modification of them necessary.

But though the pasture be formed in the best manner, with a combination of the most valuable grasses, nevertheless, a judicious mode of treatment afterwards is as essentially necessary to continue its value. By proper stocking, top-dressing, and weeding, very indifferent pastures (where the soil was adapted to the growth of grass), have been brought to a state equal to the most valuable; and, on the contrary, the richest natural pastures, by neglect of proper stocking, top-dressing, and weeding, or the too frequent repetition of hay crops, have become so unprofitable, as to require many years to bring them again to their original value. The neglect of foul hedges and road-sides, is the best possible encouragement for the propagation of those perennial weeds which infest permanent pasture land. In Warwickshire, I have seen valuable pasture land rendered nearly equal to the worst under proper management, by the intermixture of these weeds, supplied liberally from foul hedge-rows and road-sides; besides, the weeds in these nurseries afford shelter, and at particular periods, nourishment, to insects, which annoy and distress cattle in summer.

The comparative value of permanent pasture, and tillage land, is a subject out of the reach of the humble narrator of facts. All that has been here brought forward, goes no farther than to prove, that where such lands have already been converted to tillage, they may, by the means now recommended, be brought to as valuable, if not to a superior state of pasture, as before, and that in the space of four years. The means for effecting this, however, are not yet sufficiently within the power of the Agriculturist. A more general knowledge of the different grasses (and the

importance, or rather absolute necessity, of a combination of *many* different grasses, instead of two or three different species to form permanent pasture), in a short space of time, equal to the best formed by Nature, is required before sufficient encouragement can be given, to those who collect their seeds, by an extensive and *regular* demand, to supply them at the lowest price*.

By the ordinary practice of returning such soils to permanent pasture, disappointment is sure to follow; and to attempt to form a valuable permanent sward on soils not adapted to the growth of these grasses, were equally unwise; though if the subsoil be favourable, the land may be so much improved, at a moderate expense, by the means recommended in the Introduction (p. lxiv-v), as to fit it for the growth of the best grasses.

Mr. Greg, to whom the agricultural world is much indebted, and particularly for his new and excellent system of managing heavy soils, observes†, that "the soil of a great proportion of the old pastures of the united kingdom is favourable to the growth of grass; and might be broken up and returned to its former state; but there appears to be no advantage in so doing, as good grazing grounds are more productive than they could be under the best temporary arable system. In regard to those pasture lands, the soil of which is not naturally congenial to grass, it has been found the height of imprudence to break them up; for experience shews, that all the art and industry of man, when unassisted by Nature, can do very little to return them to as good a quality of pasture as before they were broken up. Loams are the most congenial to grass; and every description of tenacious soil is unsuitable to the growth of those grasses which are best adapted to grazing grounds. The grass grounds about London, and in general those close to a farm-house in arable districts, are artificial; they are reversed from three to five inches below the surface, but the subsoil is a tenacious clay. I am against general principles," continues Mr. Greg, "when exceptions can be pointed out, as in the present instance: with a spade the quality of the subsoil may be ascertained, and the possibility of reconverting the land into pasture may be determined. The only inducement to break up old pastures, even on a soil congenial to grass, would be to change the kind of grass. Nothing could prevail on me to do it on a tenacious soil, unless I intended to keep the land arable."

I have witnessed the results of several experiments on different grasses, on a large scale, conducted by Mr. Wilson on the farms of His Grace the Duke of Bedford, at Woburn. In one instance, a field containing 25 acres of old pasture land, where it was desirable to change the quality of the grass, was converted into tillage for eight years; the crops of grain during that time were most luxuriant; the following grass-seeds were then sown: meadow fox-tail, (*Alopecurus pratensis*); rough-stalked meadow-grass, (*Poa trivialis*); meadow fescue, (*Festuca pratensis*); tall oat-like soft-grass, (*Holcus avenaceus*); cock's-foot, (*Dactylis glomerata*); meadow cat's-tail, (*Phleum pratense*); rye-grass, (*Lolium perenne*); perennial red clover, (*Trifolium medium*); and white or Dutch clover, (*Trifolium repens*). It is now the third year, and the sward is much improved, and superior in the quantity of produce to that of the original pasture.

* The indefatigable and successful labours of Messrs. Gibbs, seedsmen to the Board of Agriculture, in collecting the seeds of all the different grasses of the best quality, cannot be exceeded. At the same time it is clear, that unless an extensive and *regular* demand be had for these seeds, the same as for those of Rye-grass and Clover, the seeds of those grasses must be kept on sale rather as articles of curiosity, than of utility and absolute necessity, and consequently their price uncertain.

† In one of the many valuable communications for which I am indebted to his kindness.

This, and several other experiments on rather a smaller scale, conducted with much care and impartiality by Mr. Wilson, have given results the most satisfactory; proving, as far as they go, the truth of the conclusions that had been drawn from the results of the experiments detailed in the foregoing pages.

II.

Of the different Grasses, and other Plants, which are natural to Dry, Sandy, and Elevated Soils.

The former class of grasses was distinguished by their superior size, the greater succulency of every part of their structure, and by their broad green leaves—all indicating the fertile nature and sheltered situation of the soil that produces them; and the following grasses are distinguished from these, by their dwarfish size, and the wiry appearance of every part of their structure, which sufficiently denote the poverty of their natural soil.

Sheep's-fescue, *(Festuca ovina);* viviparus-fescue, *(Festuca vivipara);* purple-fescue, *(Festuca rubra);* pubescent-fescue, *(Festuca dumetorum);* glaucous-fescue, *(Festuca glauca);* wall-fescue, *(Festuca myurus);* wall-barley, *(Hordeum murinum);* fine-bent, *(Agrostis vulgaris);* brown-bent, *(Agrostis canina);* lobed-bent, *(Agrostis lobata);* rock-bent, *(Trichodium rupestre);* snowy-bent, *(Trichodium nivium);* purple-bent, *(Trichodium caninum,* var. *muticum,* which see under the head of grasses natural to wet soils); tufted-leaved bent, *(Agrostis fascicularis);* waved hair-grass, *(Aira flexuosa);* feather-grass, *(Stipa pennata);* slender foxtail, *(Alopecurus agrestis);* hairy oat-grass, *(Avena pubescens);* blue melic-grass, *(Melica cœrulea);* upright mat-grass, *(Nardus stricta);* blood-coloured panic-grass, *(Panicum sanguinale);* green panic-grass, *(Panicum viride);* barren brome-grass, *(Bromus sterilis);* crested brome-grass, *(Bromus cristatus);* upright annual brome-grass, *(Bromus diandrus);* nodding brome-grass, *(Bromus tectorum);* alpine meadow-grass, *(Poa alpina);* alpine foxtail, *(Alopecurus alpinus);* blue moor-grass, *(Sesleria cœrulea);* crested hair-grass, *(Aira crestata);* panicled cat's-tail grass, *(Phleum paniculatum);* reflexed meadow-grass, *(Poa retroflexa);* flat-stalked meadow-grass, *(Poa compressa);* upright flat-stalked meadow-grass, *(Poa compressa,* var. *erecta);* meadow-barley, *(Hordeum pratense);* bird's-foot clover, *(Lotus corniculatus);* larger bird's-foot clover, *(Lotus major);* trefoil, or Non-such, *(Medicago Lupulina);* to which may be added, *Hedysarum onobrychis,* (sainfoin). The following, belonging to this class of grasses, have already been brought under observation: Soft brome-grass, *(Bromus mollis);* creeping soft-grass, *(Holcus mollis);* and white or Dutch clover, *(Trifolium repens).*

Dry, elevated situations, sandy heaths, and chalk lands, where the above grasses constitute the principal natural herbage, are less capable of being rendered fit for the production of superior grasses than peat-bogs, or waste lands that lie under circumstances favourable to irrigation. The latter only require proper draining, paring and burning, and the application of hot manure, as lime and sand, to fit them for the production of the best grasses, the staple or constitution of such soils being so rich and good. But dry sandy soils require more labour and ex-

pense to bring them near, in some degree, to an equivalent state of productiveness, which can only be effected by the application of large quantities of clay, and by mixing it minutely with the soil. (See remarks on this subject in the Introduction). But though poor hungry sandy soils cannot, economically, be improved in that degree as to fit them for the production of the superior grasses, like peat-soils, which in their natural or unimproved state are even less valuable than the poor sandy soils; nevertheless, there is sufficient evidence from practice, to prove that such soils may be converted to tillage for some years, and returned again to grass in a highly improved state, yielding a produce of double the value of that they originally afforded. I have witnessed improvements to this degree, on such soils, in the farms of His Grace the Duke of Bedford, at Woburn. In the fourth volume of Communications to the Board of Agriculture, there is a variety of evidence to the same effect. If it should appear, however, from the results of the experiments here made on the grasses natural to these soils, of which an account will be found in the following pages, that the kinds of grasses employed in the improvements now alluded to, were not the best fitted for the soils in question, it will follow that such improvements may be greatly extended, by adopting those grasses best fitted for the soil, and that without any additional trouble or expense.

Festuca ovina. Sheep's Fescue.

Specific character: Panicle pointing one way, crowded; spikets roundish at the base, smooth; straws slightly four-cornered; leaves bristle-shaped, roughish.

Obs.—The awns appear to be an uncertain character in this grass, as it is frequently awnless, and there are varieties of it having awns: in the *Festuca ovina hordiformis*, before mentioned, the awns are of a considerable length; but all the varieties may be distinguished at first sight from the *F. duriuscula, glabra, rubra,* &c. to which it is nearest allied, by the compact though simple appearance of the panicle, which more distinctly faces one way. Besides the present variety, (which is by far the most common), there is another, which is also awnless, but distinguished by its superior height, reddish-coloured culms, brown panicle, and brown-coloured anthers. The *Festuca tenuifolia* much resembles this, but the panicle is less crowded, the leaves are as long, or longer than the culms, and bent downwards, while those of the present species are shorter, and grow upright. E. Bot. 585; Host. t. 84, var. awned; Wither. Arr. ii. p. 152.

Native of Britain. Root fibrous, perennial.

Experiments.—At the time of flowering, the produce from a light sandy soil, is,

			oz.		lbs.	
Grass, 8 oz. The produce per acre - - - -			87120	0 =	5445	0
64 dr. of grass afford of nutritive matter -	75 gr.	- - -	3403	2 =	212	11
The produce of the space, ditto - -	150					
The produce of latter-math is,						
Grass, 5 oz. The produce per acre - - - - -			54450	0 =	3403	2
64 dr. of grass afford of nutritive matter -	1 dr. 1 qr.	- -	1063	7 =	66	7
At the time the seed is ripe, the produce is,						
Grass, 8 oz. The produce per acre - - - - -			87120	0 =	5445	0
64 dr. of herbage afford of nutritive matter -	45 gr.	- -	2041	14 =	127	9
The produce of the space, ditto - -	90					

When cultivated on a heath soil, the produce was somewhat less than the above, but from a rich sandy loam, the produce afforded was greater than from the light sandy soil; but, as the superior pasture grasses thrive well on this last-mentioned soil, and afford a produce superior to that of the Sheep's-fescue on the same soil, as 3 to 1, its comparative value may be considered only with regard to its natural soil and the grasses it produces. The smallness of the produce renders it entirely unfit for hay, and the dry weight was in consequence not ascertained.

Linnæus affirms, that sheep have no relish for hills and heaths that are destitute of this grass. Gemelin, in his Flora Siberica, informs us likewise, that the Tartars choose to fix during the summer where this grass is in greatest plenty, because it affords a most wholesome food for all sorts of cattle, but chiefly sheep. Dr. Anderson, in his Agricultural Essays, affirms that it is capable of affording an immense quantity of hay. Mr. Curtis, in his Practical Observations on British Grasses, has justly combated this opinion of Dr. Anderson, and records that Sheep's Fescue is more fitted for the formation of grass plats; but for this purpose it will not be found to succeed, unless the soil is nearly as dry and light as that on which it is spontaneously produced.

Festuca ovina.

Sheep's Fescue.

When its produce, and nutritive powers are compared with those of the purple fescue (*Festuca rubra*), on the same soil, its inferiority is great.

								lbs.	
Festuca ovina, as above, affords of nutritive matter from three crops, per acre								405	0
Festuca rubra, purple fescue, affords of nutritive matter:									
	dr.	qr.							
From the grass at the time of flowering	2	0	per acre	-	-	-	340 5	659	5
From the grass at the time the seed is ripe	1	2	ditto	- - - - -			239 4		
From the grass of the latter-math -	1	2	ditto	- - - -			79 12		

The comparative degree of nourishment which the grass of the *Festuca rubra* affords at the time of ripening the seed, and the latter-math, exceeds that of the *Festuca ovina* at the same stages of growth, in the proportion of nearly 14 to 11; and exceeds the *F. ovina*, in regard to the total produce of the season, in the proportion nearly of 11 to 7.

From the trial that has here been detailed, the Sheep's Fescue does not prove to possess the nutritive powers generally ascribed to it. It has the advantage of a fine foliage, which is succulent, and may therefore, very probably, be better adapted to the masticating organs of sheep than the larger grasses, whose nutritive powers are shewn to be greater. Hence, on situations where it naturally grows, and as pasture for sheep, it may possibly be inferior to none on the same soil, in the like state of nature. It flowers in the third week of June, and the seed is ripe about the last of July.

Festuca vivipara. Viviparous Fescue-grass.

Specific character: Panicle flowering on one side; flowers keel-compressed, awnless, with the calyx somewhat pubescent. E. Bot. 1355.

Obs.—I have cultivated this grass on a variety of soils, and it has always continued viviparous on them all. I never could obtain a floret with either stamen or pistil. The germen, in its first stage, appears like a minute globule of water, visible only with the microscope; after the spike is developed, it gradually assumes an oblong figure, becomes pointed, and at last puts forth a single leaf, after the manner of the perfect seed of grasses; other leaves succeed to this, till the weight of these, now a perfect plant of grass, except the root, forces it to fall from the spike on the ground, where it soon strikes root. This is a curious exception to the general law of Nature, in the propagation of plants by their seed. Here is a plant, which has every part of a flower except the two essential parts, stamens and pistils, for its propagation, and for its admission into this class of the system of Linnæus. Yet from this imperfect flower it produces perfect plants. A great number of other grasses are viviparous, as *Alopecurus pratensis, Cynosurus cristatus, Poa alpina, Phleum pratense, Anthoxanthum odoratum, &c. &c.* but in these the seed is first perfected, and merely vegetates in the husk from accidental circumstances, as growing in shaded places, and from long continuance of moist warm weather.

Experiments.—At the time of flowering, or when the spike is perfectly developed, the produce from a light sandy soil, is,

					oz.		lbs.	
Grass, 10 oz. The produce per acre	-	-	-	-	108900	0 =	6806	4
64 dr. of grass afford of nutritive matter	-	80 gr.						
The produce of the space, ditto	- -	200	-	-	4537	8 =	283	9

Festuca vivipara.

Viviparous Fescue-grass.

The latter-math produce is very little; less, by one-half, than that of the *Festuca ovina:* the viviparous heads form the chief part of the above weight of produce, the foliage being very inconsiderable, and the culms small. The quantity of nutritive matter it contains is greater than that afforded by an equal weight of the grass of the *Festuca ovina,* which appears to be entirely owing to the number and rudiments of young plants contained in the spikes of the *Festuca vivipara.* The nutritive matter contains less sugar, and more bitter extractive, than the nutritive matters of the *Festuca ovina, Festuca duriuscula,* and *Festuca Cambrica.*

This grass can only be propagated by parting the roots, or by planting the young plants formed in the ear. This might easily be effected by either means, were the grass of sufficient value to be cultivated; but from the trials that have been made of it here, it appears to have no excellence that can recommend it to the notice of the Agriculturist. It is natural to alpine situations.

Festuca rubra. Creeping Fescue, Purple Fescue.

Specific character: Panicle spreading; florets with long awns; root creeping. Flo. Ger. 329.

Obs.—There are two varieties of this species; one with narrow bristle-shaped root-leaves, and the other with broader leaves. It has much affinity to the *Festuca duriuscula,* from which it is distinguished by the leaves, which are broader and longer; the branches of the panicle are also longer; the sheaths of the leaves are always more or less pubescent; but the essential and unerring distinction is the creeping root, which, in the broader-leaved variety, is nearly as strong as that of common Couch-grass; in the smaller-leaved variety the root is less powerfully creeping. The resemblance which exists between the *Festuca duriuscula, Festuca glabra, Festuca Cambrica,* and *Festuca rubra,* is very great; but the difference, with regard to agricultural merits or value, is not great, except what arises from the creeping root of the latter; the distinction here, in this instance, of most concern to the Agriculturist. The name, purple, *(rubra),* as applied to denote such a property of this grass, is certainly very erroneous, the other species having this colour at the time the seed is ripe, in common and in a much greater degree than this one. The awned variety of the *Festuca ovina* is most deserving of the name *rubra.*

Native of Britain. Perennial.

Experiments.—At the time of flowering, the produce from a light sandy soil, is,

	dr.	qr.	oz.		lbs.	
Grass, 15 oz. The produce per acre - - - -			163350	0 =	10209	6
80 dr. of grass weigh, when dry - -	34	0				
The produce of the space, ditto - -	102	0	69423	12 =	4338	15
The weight lost by the produce of one acre in drying - - - -					5860	7
64 dr. of grass afford of nutritive matter -	1	2				
The produce of the space, ditto - -	5	$2\frac{1}{2}$	3828	8 =	239	4

At the time the seed is ripe, the produce is,

Grass, 16 oz. The produce per acre - - - -			174240	0 =	10890	0
80 dr. of grass weigh, when dry - -	36	0				
The produce of the space, ditto - -	115	$0\frac{3}{16}$	78408	0 =	4900	8
The weight lost by the produce of one acre in drying - - - -					5989	8

Festuca rubra.
Creeping Fescue.

	dr.	qr.		oz.		lbs.	
64 dr. of grass afford of nutritive matter -	2	0	- -	5445	0 =	340	5
The produce of the space, ditto - -	8	0					
The weight of nutritive matter, in which the crop, at the time the seed is ripe, exceeds that at the time of flowering, is - - - - - - - -						101	0

The proportional value in which the grass, at the time the seed is ripe, exceeds that at the time of flowering, is as 4 to 3.

The produce of latter-math is,

Grass, 5 oz. The produce per acre - - - -				54450	0 =	3403	2
64 dr. of grass afford of nutritive matter -	1	2	- - -	1276	2 =	79	12

The above details may be sufficient to shew that the Creeping Fescue has no superior merit over those species it resembles in habits, to compensate for the impoverishing effects of its creeping roots to the soil. The first and second years of its growth from seed, the produce is greater than is shewn in the above statements of its three year old produce. After the second year the produce declines till the seventh or eighth, when it becomes so thin and diminutive, as hardly to amount to one-sixth of the above: this is the case with creeping roots in general; but though they impoverish thus the soil for their own maintenance, nevertheless the fibrous-rooted species succeed well when planted on the ground so impoverished by the creeping roots of the *Festuca rubra:* the nutritive matter of the creeping roots consists almost entirely of mucilage, while the greater proportion of the nutritive matters of the fibrous species (*F. duriuscula, F. Cambrica,* and *F. glabra)* consists of saccharine and bitter extractive matters.

Flowers in the third week of June, and ripens the seed in the second week of July.

Festuca dumetorum. Pubescent Wood-fescue.

Specific character: Panicle branches pointing in many directions; spikets pubescent; leaves thread-shaped. Wither. Arr. ii. p. 154; Flo. Dan. 700.?

Obs.—Spikets straddling, some pointing upwards, some slanting, some nearly horizontal. (Wither.)—The whole plant is of a light glaucous colour, the spikets nearly white with the numerous fine hairs that clothe them. Culms slanting; leaves long, slender, and pointing downwards. The peculiar pubescence of the spikets, and the distorted figure of the panicle, which remains unaltered from seed, particularly distinguishes this species from the Hard, Smooth, Welsh, and Creeping Fescues.

Native of Britain. Root perennial, slightly creeping.

Experiments.—At the time of flowering, the produce from a rich black sandy soil, incumbent on clay, is,

	dr.	qr.		oz.		lbs.		
Grass, 16 oz. The produce per acre - - -			- - -	174240	0 =	10890	0	0
80 dr. of grass weigh, when dry - -	40	0						
The produce of the space, ditto - -	128	0	- -	87120	0 =	5445	0	0
64 dr. of grass afford of nutritive matter -	1	0						
The produce of the space, ditto - - -	4	0	- - -	2722	8 =	170	2	8
The weight lost by the produce of one acre in drying			- - - -			5445	0	0
At the time the seed is ripe, the produce is,								
Grass, 14 oz. The produce per acre - -			- - -	152460	0 =	9528	12	0

Festuca dumetorum.

Wood Fescue.

	dr.	qr.	oz.		lbs.		
80 dr. of grass weigh, when dry - -	24	0	- - 45738	0 =	2858	10	0
The produce of the space, ditto - -	67	$0\frac{4}{5}$					
The weight lost by the produce of one acre in drying - - - -					6670	2	0
64 dr. of grass afford of nutritive matter -	1	2	- - 3573	4 =	223	5	4
The produce of the space, ditto - -	5	1					
The weight of nutritive matter, in which the crop at the time the seed is ripe exceeds that at the time of flowering, is - - - - - - -					53	2	12
The grass, at the time the seed is ripe, contains more nutritive matter than that at the time of flowering, in the proportion of 3 to 2.							
The produce of latter-math is,							
Grass, 6 oz. The produce per acre - - - -			65340	0 =	4083	12	0
64 dr. of grass afford of nutritive matter -	1	0	- - - 1020	12 =	63	12	12

The grass of the latter-math, and that at the time of flowering, contain equal proportions of nutritive matter; and the grass, at the time the seed is ripe, is superior to these, in the proportion of 3 to 2.

This grass is a native of woods where the soil is dry and sandy. I found it first in Aspley Wood in 1810, whence the annexed specimen. From the above details, a single crop of this species is superior to that of the *Festuca ovina;* but it is much later in the production of foliage in the spring, and the latter-math, or reproductive power of this grass, is much inferior to that of the *Festuca ovina.* It ripens a sufficiency of seed, which vegetates freely. Its nutritive powers are inferior to those of the *Festuca ovina,* in the proportion of 3 to 2. From all which, it at present appears to be one of the most inferior kinds of grass.

Flowers about the second week of June, and the seed is ripe about the second and third weeks of July.

Festuca glauca. Glaucous Fescue-grass.

Specific character: Panicle rather spreading; spikets spear-shaped, awned; culms and leaves smooth. Whole plant glaucous.

Obs.—This plant differs from the *Festuca glauca* of Host. (t. 88) in the stem, which is round, smooth, and straight. The leaves are longer and smooth. The spikets less spear-shaped; the panicle is contracted before and after flowering: spikets 5-7 flowered; awns short and rigid. Mr. Curtis, in his enumeration of British grasses, mentions this as indigenous, and on this authority it is here entered, as I never could find it in its natural state. There is another Glaucous Fescue in the Woburn collection, which differs from this one in being in every respect smaller, and of a much deeper glaucous colour; the root-leaves are very short, and bent inwards.

Native of Britain. Root perennial, fibrous.

Experiments.—At the time of flowering, the produce from a brown loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 14 oz. The produce per acre -		- - -	152460	0 =	9528	12	0
80 dr. of grass weigh, when dry - -	32	0					
The produce of the space, ditto - -	89	$2\frac{2}{5}$	- - 60984	0 =	3811	8	0
The weight lost by the produce of one acre in drying - - - -					5717	4	0

Festuca glauca.
N
Glaucous Fescue.

	dr.	qr.		oz.		lbs.		
64 dr. of grass afford of nutritive matter -	3	0	- -	7146	9	446	10	0
The produce of the space, ditto -	10	2						
At the time the seed is ripe, the produce is,								
Grass, 14 oz. The produce per acre - - - - - -				152460	0 =	9528	12	0
80 dr. of grass weigh, when dry -	32	0	- -	60984	0 =	3811	8	0
The produce of the space, ditto - -	89	$0\frac{3}{5}$						
The weight lost by the produce of one acre in drying - - - -				5717	4	0		
64 dr. of grass afford of nutritive matter -	1	2	- -	3573	4 =	223	5	4
The produce of the space, ditto - -	5	1						
The proportional value, in which the grass at the time of flowering is inferior to that at the time the seed is ripe, is as 2 to 1.								
The produce of latter-math, is,								
Grass, 7 oz. The produce per acre - - - -				76230	0 =	4764	6	0
64 dr. of grass afford of nutritive matter -	1	2	- - -	1786	10 =	111	10	10

The proportional difference between the flowering and seed crops of this grass, is directly the reverse of that of the *Poa trivialis*; and it affords one out of many proofs that might be brought forward, of the value of the culms in grasses intended for hay. The culms at the time of flowering are of a very succulent nature; but from that period till the seed be perfected, they gradually become dry and wiry; nor do the root-leaves sensibly increase in number or in size, but a total suspension of increase appears in every part of the plant, the roots and seeds excepted. The straws or culms of the *Poa trivialis* are, on the contrary, at the time of flowering, weak and tender; but as they approach the period of ripening the seed they become firm, though still succulent. This economy in the growth of the *Poa trivialis*, is nearly the same as in all the early flowering grasses, as they contain more nutritive matter after the time of flowering than before, or at that period of growth: the latter flowering grasses, with few exceptions, afford more nutritive matter just after flowering, than when the seed is perfected. Whatever the cause may be, it seems probable that the weak influence which the sun at that early season of the year has upon these grasses, compared to that at Midsummer, must have a share in the cause of this difference of nutritive powers in grasses at the same stage of growth.

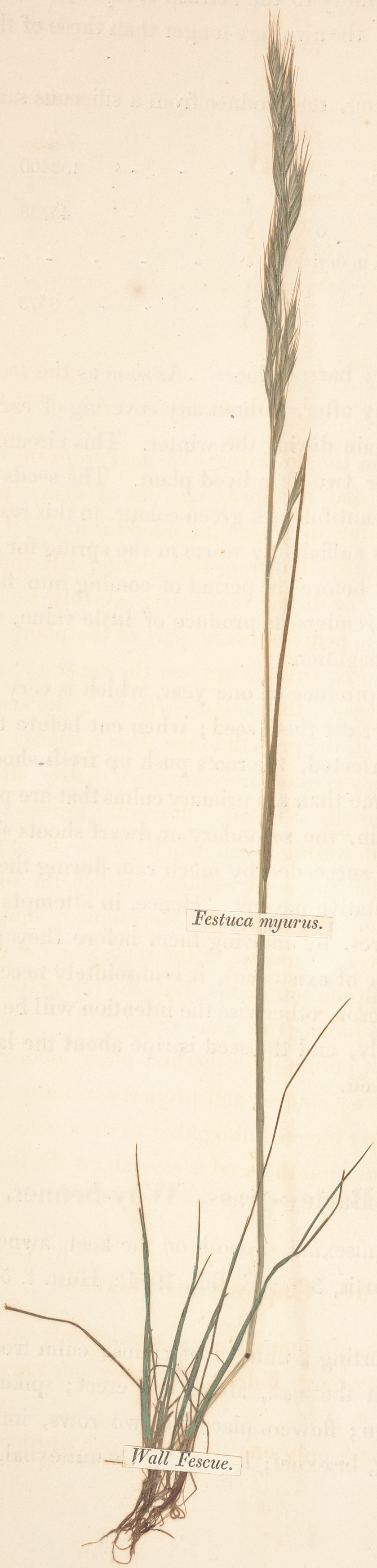
The *Festuca glauca* is a native of alpine situations, but thrives better when cultivated on lower ground, than most other species having the same origin. Its merits, however, though they do not appear sufficiently great to entitle it to the first place among the superior grasses for light soils, yet on account of its hardy nature, and property of forming a thick turf, as well as being nutritive, prevent it from being rejected altogether as of no value.

Flowers in the second week of June, and the seed is ripe about the first week of July.

Festuca myurus. Wall-fescue, Capon's-tail Grass.

Specific character: Panicle spike-like, drooping; calyx, smaller valve very minute; awns long, rough; sheaths of the leaves very long, hiding the lower portion of the culm. Wither.; Flo. Ger.; E. Bot. 1412; Host. t. 93.

Obs.—Root annual. The flowers have only one stamen, which distinguishes it from all other


Festuca myurus.
Wall Fescue.

species of Fescue. It has great affinity to the *Festuca bromoides.* The inner valve of the blossom is fringed towards the top; the awns are longer than those of the *Festuca bromoides.* Native of Britain.

Experiments.—At the time of flowering, the produce from a siliceous sandy soil, is,

	dr.	qr.	oz.		lbs.		
Grass, 14 oz. The produce per acre - - - - - -			152460	0 =	9528	12	0
80 dr. of grass weigh, when dry - -	24	0	- -	45738	0 =	2858	10	0
The produce of the space, ditto - -	67	$0\frac{4}{5}$					
The weight lost by the produce of one acre in drying - - - - - -				6670	2	0
64 dr. of grass afford of nutritive matter -	1	2	- - -	3573	4 =	223	5	4
The produce of the space, ditto - -	5	1					

This grass is found on walls and dry barren places. As soon as the seeds are ripe, they fall out of the husks, and vegetate quickly after, without any covering of earth; the plants are of the finest green colour, which they retain during the winter. This circumstance seems to have led some to suppose it a biennial, or two-year lived plant. The seeds being numerous, the young plants form a turf of the most beautiful dark green colour, in this respect surpassing every other grass. As soon as the weather is sufficiently warm in the spring for the growth of grasses in general, this property declines, and before the period of coming into flower, it is invariably attacked with the rust disease, which renders its produce of little value, were it even afforded in sufficient quantity to induce its propagation.

The above details shew the whole produce of one year, which is very inconsiderable. The chief effort of annual plants is to perfect their seed; when cut before the time of flowering, and at any time before the seed be perfected, the roots push up fresh shoots, which flower and perfect seed in a much less space of time than the primary culms that are previously taken away. If the first shoots are suffered to remain, the secondary or dwarf shoots seldom appear, unless when a continuance of dry weather is succeeded by much rain during the time of inflorescence, which gives a new impulse to the vegetative powers. Hence, in attempts to eradicate these unprofitable annual grasses from pastures, by mowing them before they perfect their seed, (to which only they owe their continuance of existence), it is absolutely necessary that the mowing should be often repeated during the season, otherwise the intention will be completely frustrated.

It flowers in the first week of July, and the seed is ripe about the last of the same month. Birds appear to be very fond of the seed.

Hordeum murinum. Wall Barley-grass, Way-bennet.

Specific character: Lateral florets unisexual, smooth on the keel, awned; involucrum of the intermediate florets fringed. Curtis, 325; E. Bot. 1971; Host. t. 53; Wither. 171; *Rye-grass,* &c.

Obs.—Root fibrous, annual, supporting a number of culms; culm from half a foot to a foot and a half high, procumbent at the base, afterwards erect; spike-stalk brittle, flexuose, compressed, rough on the margin; flowers placed in two rows, imbricated, roundish, intermediate flower nearly sitting, bisexual; lateral florets unisexual, or neuter. Flo. Ger. 404; Wither. Arr. 171.

Hordeum murinum.
Wall Barley-grass.

Experiments.—At the time of flowering, the produce from a clayey loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 18 oz. The produce per acre -			196020	0 =	12251	4	0
80 dr. of grass weigh, when dry - -	28	0	68607	0 =	4287	15	0
The produce of the space, ditto - -	100	$3\frac{1}{5}$					
The weight lost by the produce of one acre in drying			7963	5	0		
64 dr. of grass afford of nutritive matter -	3	$0\frac{1}{10}$	9188	7 =	574	4	7
The produce of the space, ditto - -	13	2					
At the time the seed is ripe, the produce is,							
Grass, 12 oz. The produce per acre -			130680	0 =	8167	8	0
80 dr. of grass weigh, when dry - -	28	0	45738	0 =	2858	10	0
The produce of the space, ditto - -	67	$0\frac{4}{5}$					
The weight lost by the produce of one acre in drying			5308	14	0		
64 dr. of grass afford of nutritive matter -	2	0	4083	12 =	255	3	12
The produce of the space, ditto - -	6	0					

The produce of this annual, at the time the seed is ripe, contains more nutritive matter than at the time of flowering: this is a contrary result to all others of the annual grasses, but it is, I believe, chiefly owing to a part of the seed having been left on the spikes, while in all other instances, it was separated from the grass previous to its being submitted to experiment.

The above details prove this to be one of the most inferior grasses, with respect to nutritive powers. The long awns with which it is armed, must make it dangerous to the mouths of horses when it enters into the composition of their hay. Fortunately, it is uncommon in pastures, but chiefly confined to road-sides, and other beaten or barren places. I never could observe this grass eaten by cattle of any description, not even by the half-starved animals which feed by road-sides, where this is often the most prevalent grass. The nutritive matter consists chiefly of mucilage and insoluble extractive matter: it afforded me no sugar. However, Dr. Withering says it is eaten by sheep and horses; and that it feeds the brown moth, *Phalæna granella,* and the barley-fly, *Musca frit.* Professor Martyn observes, that it is an old notion, that this grass is Barley degenerated; and that Haller seriously combats this error, but it is surely too common a one to merit contradiction.

It flowers about the first week of July, and the seed is ripe about the end of the same month.

Agrostis vulgaris. Common Bent, Fine Bent-grass.

Agrostis arenaria, Agrostis capillaris, Hudson. *Agrostis vulgaris,* Withering.

Specific character: Panicle spreading, branches bare at the base; florets numerous; calyx inner valve smooth, outer serulated upwards; blossom inner valve but half the size of the outer, deciduous. Wither. Arr. 132.

Obs.—This species has four varieties, according to Dr. Schrader. The first is distinguished by being awned, (see our *Agrostis canina,* and *Trichodium caninum).* The second by awnless and diseased flowers, (see *Agrostis pumila,* of Willd. Spec. Plant. i. p. 371). The third by its diseased awned flowers; the awn in this, is jointed and bent before it reaches the apex of the blossom valve. The fourth, by having the flowers viviparous. *Agrostis sylvatica.*

Agrostis vulgaris.
Common Bent.

Experiments.—At the time of flowering, the produce from a siliceous sandy soil, is,

	dr.	qr.	oz.		lbs.		
Grass, 15 oz. The produce per acre - - - - - -			163350	0 =	10209	6	0
80 dr. of grass weigh, when dry - -	36	0	- -	73507	8 =	4594	3 8
The produce of the space, ditto - -	108	0					
The weight lost by the produce of one acre in drying - - - - - -				5615	2	8	
	dr.	gr.					
64 dr. of grass afford of nutritive matter -	3	10	- - -	8507	13 =	531	11 13
The produce of the space, ditto - - -	12	15					

At the time the seed is ripe, the produce is,

	dr.	qr.	oz.		lbs.		
Grass, 14 oz. The produce per acre - - - -			152460	0 =	9528	12	0
80 dr. of grass weigh, when dry - -	40	0	- -	76230	0 =	4764	6 0
The produce of the space, ditto - -	112	0					
The weight lost by the produce of one acre in drying - - - -				4764	6	0	
64 dr. of grass afford of nutritive matter -	1	$2\frac{3}{16}$	- -	4019	15 =	251	3 15
The produce of the space, ditto - -	5	$1\frac{5}{8}$					

The produce of latter-math is,

Grass, 4 oz. The produce per acre - - - - -	43560	0 =	2722	8	0
64 dr. of grass afford of nutritive matter 1 2 - - -	1020	15 =	63	12	15

A given space of the above sandy soil, and another of a clayey loam, were sown with the seeds of this grass on the 20th of May, 1813. The seeds vegetated, and the produce was cut in the month of August following. The seeds of the creeping-rooted bent, *(Agrostis alba)*, and of the larger creeping-bent or fiorin, *(Agrostis stolonifera*, var. *latifolia)*, were likewise sown at the same time, and treated under the same circumstances. The results were as follows:

	oz.	dr.	qr.
The *Agrostis vulgaris*, on the siliceous sandy soil, from the time of sowing, till the produce was cut, being eleven weeks and five days, afforded of grass - - - -	1	12	0
From the clayey loam, it afforded of grass, in the same time - - - -	1	8	0
The *Agrostis alba*, on the siliceous sandy soil, from the time of sowing till the produce was cut, being eleven weeks and five days, afforded of grass - - - - -	5	0	0
From a clayey loam, it afforded of grass in the same time - - - -	5	8	0
The *Agrostis stolonifera*, var. *latifolia*, on the siliceous sandy soil, from the time of sowing till the produce was taken, being eleven weeks and five days, afforded of grass - -	5	4	0
From a clayey loam, it afforded, in the same time, of grass - - - - - -	1	12	0

The Fiorin, in this experiment, is less productive on a clayey soil than the Creeping-rooted Bent, and even much less on the clayey than on the sandy soil; however, though its progress be at first slower on the clayey loam, yet, in the second year, the produce from the clayey loam was exactly triple the weight of that from the sandy soil. The Fiorin afforded the greatest produce on the second and third years; after this, unless top-dressings are applied, the produce declines. On peat soils, this effect of the fibrous surface roots, is much less. The Common Bent is one of the earliest of the Bent grasses; in this respect it is superior to every other of this family, but inferior to several of them in the quantity of produce it affords and the nutritive matter it contains. It is the most common grass on natural sandy pastures; and even on more tenacious soils that are elevated and exposed, it is frequent.

It flowers from the third week of June till the second week of July, and the seed is ripe the beginning of August.

Agrostis canina. Brown Bent.

Agrostis vulgaris, var. 1, (Dr. Smith); *Agrostis canina,* (Withering's Arr.)

Specific character: Calyx valves nearly equal, blossom valves very unequal; awn, jointed, twice the length of the corolla, fixed just below its middle.

Obs.—The *Agrostis canina* of Dr. Smith having only one valve to the corolla, has been by Schrader referred to the genus *trichodium.* As it is a much less common plant than the *vulgaris* before described, and as it differs so much from the *vulgaris,* in the properties which constitute the Farmer's distinguishing characters of grasses, the name *canina* is here retained. It is distinguished from the *Agrostis vulgaris* by its panicle, which is larger, and less crowded with florets: the culms are ascending, not so upright as those of the *vulgaris*; indeed, by this last distinction it is known at first sight from the other. The awns, which are knee-bent also, leave no room for doubt. The *vulgaris* is more common to sandy soils; the *canina* to clayey soils; and is therefore introduced here for the convenience of comparison. There is another variety of this grass without awns, distinguished from the *A. vulgaris* by its ascending straws, and meagre wide-spreading panicle.

Native of Britain. Root fibrous, perennial.

Experiments.—At the time the seed is ripe, the produce from a sandy loam, is,

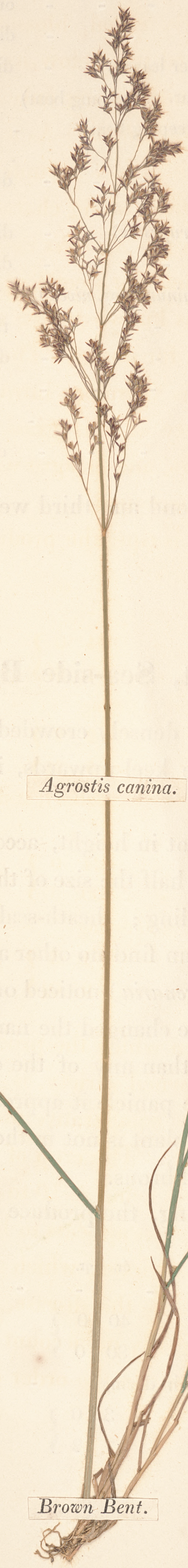
	dr.	qr.		oz.		lbs.		
Grass, 9 oz. The produce per acre - - - -				98010	0 =	6125	10	0
80 dr. of grass weigh, when dry - -	34	0	- -	41654	4 =	2603	6	4
The produce of the space, ditto - -	61	$0\frac{4}{5}$						
The weight lost by the produce of one acre in drying - - - -				3522	3	12		
64 dr. of grass afford of nutritive matter -	2	2	- -	3828	8 =	239	4	8
The produce of the space, ditto - -	5	$2\frac{1}{2}$						

Of the awnless variety, *(Agrostis canina,* var. *mutica),* at the time the seed is ripe, the produce is,

Grass, 21 oz. The produce per acre - - - -				228690	0 =	14293	2	0
80 dr. of grass weigh, when dry - -	24	0	- -	68607	0 =	4287	15	0
The produce of the space, ditto - -	100	$3\frac{1}{5}$						
The weight lost by the produce of one acre in drying - - - - - - -				10005	3	0		
64 dr. of grass afford of nutritive matter -	1	3	- -	6253	3 =	390	13	3
The produce of the space, ditto - -	9	$0\frac{3}{4}$						

The weight of nutritive matter, in which the produce of one acre of the awnless variety of *Agrostis canina* exceeds that of the awned variety, is 151.8.

Those results go to prove that the comparative merits of the *Agrostis vulgaris* exceed those of the *Agrostis canina* nearly as 2 to 1. The crop of the awnless variety is greater than that of the awned, but is much less nutritive, being as 10 to 7: the spring and autumn produce is likewise superior. Neither of these varieties appears to be of much value to the Farmer. The rust attacks the culms and leaves of both varieties, which gives the plants a dirty brown appearance; the *Agrostis vulgaris* is always free from this disease. As this family of grasses has been held in little esteem by Farmers, principally on account of their lateness of flowering, it may be of use to bring them into one view, in the order of their early produce of herbage in the spring.



Agrostis canina.

Brown Bent.

	The apparent difference of Time.	Nutritive Powers. dr.	qr.
Agrostis vulgaris, (common bent)	middle of April	1	2¾
Agrostis palustris, (marsh bent)	one week later	2	3
Agrostis stolonifera, var. *latifolia*, (fiorin)	ditto	3	2
Agrostis stolonifera, var. *angustifolia*, (smaller leaved)	ditto	3	0
Agrostis stolonifera, var. *aristata*, (awned var. of creeping bent)		2	6
Agrostis stolonifera, var. *sylvatica*, (wood creeping bent)		2	0
		dr.	gr.
Agrostis alba, (creeping-rooted bent)	ditto	2	6
		dr.	qr.
Agrostis stricta, (upright bent, *Trichodium rupestre*)	ditto	1	2
Agrostis canina, (brown bent)	ditto	1	3
Agrostis nivea, (snowy bent, *Trichodium caninum*, var. *nivea)*		2	0
Agrostis lobata, (lobed bent-grass)	three weeks later	3	0
Agrostis repens, (black couch bent-grass)	ditto	3	0
Agrostis Mexicana, (Mexican bent-grass)		2	0
Agrostis fascicularis, (bundled-leaved bent)		2	0
Agrostis lateriflora, (branching bent-grass)	ditto	2	0

The Brown Bent flowers in the second and third weeks of July, and ripens the seed in the end of August.

Agrostis lobata. Lobed Bent, Sea-side Bent.

Specific character: Panicle spike-like, densely crowded with florets; calyx-valves equal, acuminate, outer serrulated from the keel upwards, inner valve only towards the top, very unequal, egg-shaped.

Obs.—Stems from four inches to a foot in height, according to the nature of the soil it grows in; inner valve of the blossom one half the size of the outer; leaves flat, those of the culm very rough; culms smooth, ascending; sheath-scale broad, divided at top: the whole plant of a light green colour. I can find no other account of this grass but the following: "Finding this maritime species *(arenaria)* noticed originally by us on the Devonshire coast, not confined to sandy soils, we have changed the name to that of *lobata;* the panicle being more obviously divided into lobes than any of the other species, it comes near to *alba.*" *Curtis, Obser.*—In the form of the panicle it approaches the nearest to the lesser-leaved variety of Creeping Bent, but the plant is not in the least stoloniferous.

Native of Britain. Root perennial, fibrous.

Experiments.—At the time of flowering, the produce from a siliceous sandy soil, is,

	dr.	qr.		oz.		lbs.		
Grass, 10 oz. The produce per acre				108900	0 =	6806	4	0
80 dr. of grass weigh, when dry	40	0						
The produce of the space, ditto	80	0		54450	0 =	3403	2	0
The weight lost by the produce of one acre in drying				3403	2	0		
64 dr. of grass afford of nutritive matter	3	0						
The produce of the space, ditto	7	2		5104	11 =	319	0	11

Agrostis lobata.
Lobed Bent.

At the time the seed is ripe, the produce is,

	dr.	qr.	oz.		lbs.		
Grass, 9 oz. The produce per acre - - - -			98010	0 =	6125	10	0
80 dr. of grass weigh when dry - -	35	0	- -	42879	6 =	2679	15	6
The produce of the space, ditto - -	63	0					
The weight lost by the produce of one acre in drying - - - -				3445	10	10
64 dr. of grass afford of nutritive matter -	3	0	- - -	4594	3 =	287	2	3
The produce of the space, ditto - - -	6	3					
The weight of nutritive matter, which is lost by leaving the crop till the seed be ripe, is -				31	14	8

The general appearance of this plant indicates the inferior comparative value manifested in the above details. It appears, according to the information quoted above, from Mr. Curtis, to be chiefly confined to the sea-coasts. I have never met with it in a wild state. It does not appear to be of much value to the Agriculturist. Probably, however, in such places as are exposed to the spray of the ocean, it may succeed better, and afford a greater produce; its nutritive powers are far from being very inconsiderable. It ripens an abundance of seed, which vegetates freely. In the figure and disposition of the florets and panicle, it seems to connect the *Agrostis verticillata, Agrostis stolonifera,* var. *angustifolia,* and *Agrostis alba,* in a series.

It flowers in the first week of August, and the seed is ripe about the end of the same month.

Agrostis stricta. Rock Bent, Upright Bent.

Trichoduim rupestre. (Schrader.)

Specific character: Panicle branches subdivided, roughish; calyx valves acuminate; blossom one valve, awned; awn fixed a little above the base.

Obs.—This species of Bent is distinguished from the *Agrostis vulgaris,* and *Agrostis canina,* to which in habit it approaches, by the corolla or blossom being but of one valve; from the *Agrostis nivea, vel Trichodium niveum,* by the erect disposition of the stem, and the awn which is fixed but a little above the base of the valve: the valve has likewise two short awn-like points, which are a continuation of the nerves of the valve. The panicle is also less divided, more spear-shaped, and the calyx is acuminated. Whole plant of a fine deep green colour, by which it is distinguished at first sight from every other species of Bent-grass.

Native of Britain. Root fibrous, perennial.

Experiments.—At the time of flowering, the produce from a bog soil, is,

	dr.	qr.	oz.		lbs.		
Grass, 14 oz. The produce per acre - - - - - -			152460	0 =	9528	12	0
80 dr. of grass weigh when dry - -	40	0	- -	76230	0 =	4764	6	0
The produce of the space, ditto - -	112	0					
The weight lost by the produce of one acre in drying - - - -				4764	6	0
64 dr. of grass afford of nutritive matter -	1	$2\frac{3}{16}$	- -	4019	15 =	251	3	15
The produce of the space, ditto - -	5	$1\frac{5}{8}$					

Agrostis stricta.

Rock Bent.

	dr.	qr.	oz.	lbs.
At the time the seed is ripe, the produce is,				
Grass, 11 oz. The produce per acre - - - - -			119790 0 =	7486 14 0
80 dr. of grass weigh when dry - -	29	0	- - 43423 14 =	2713 15 14
The produce of the space, ditto - -	63	$3\frac{1}{5}$		
The weight lost by the produce of one acre in drying - - - -				4772 14 2
64 dr. of grass afford of nutritive matter -	1	2	- - 2807 9 =	175 7 9
The produce of the space, ditto - -	4	$0\frac{5}{10}$		
The produce of latter-math is,				
Grass, 4 oz. The produce per acre - - - -			43560 0 =	2722 8 0
64 dr. of grass afford of nutritive matter -	1	2	- - 1020 15 =	63 12 15
The weight of nutritive matter, which is lost by leaving the crop till the seed be ripe, is -				75 8 6

As it will be found a vain attempt to cultivate or maintain grasses on soils of a nature opposite to those which naturally produce them; it is therefore necessary, in ascertaining the comparative value of a grass, that its merits and properties be compared with those of such others only, as affect a similar soil. If we compare the *Agrostis vulgaris* with this species, it will be found superior in the proportion nearly of 5 to 3.

The *Agrostis vulgaris*, (common bent), affords in one season, per acre

	lbs.		lbs.
Grass, at the time of flowering - -	10209		
Or, hay - - - - -	4594	which affords of nutritive matter -	501
Latter-math grass - - - -	2722		
The Rock Bent-grass, as above, affords in one season, a produce of			
Grass, at the time of flowering - -	9528		
Or, hay - - - - - -	4764	which affords of nutritive matter -	314
Latter-math grass - - - - -	2722		

This species being therefore inferior to the Common Bent in most points, its value to the Agriculturist can be but little. The only property that renders it worthy of notice, is the small degree in which it impoverishes the soil: when cultivated on a poor siliceous sandy soil, the produce, though inferior to the above, continued for six years without diminishing in the yearly quantity, and without any manure whatever being applied: a circumstance which was not manifested in any other species of grass.

Agrostis nivea. Snowy Bent, Straw-coloured Bent-grass.

Trichodium caninum, var. *stramineis arista calicem vix excedente.* (Schrader.)

Specific character: Panicle branches subdivided, diverging, flexuose; calyx acute; corolla 1-valved, valve awned, awn longer than the valve, protruding from the back, fixed a little below the middle.

Obs.—This grass is evidently nearly allied to the *Agrostis canina* of Dr. Smith; the awn is shorter, branches of the panicle almost smooth, culm more ascending. The whole plant, except the panicle when in flower and seed, of a light straw colour. The branches are numerous, and when in flower, the panicle assumes that appearance which it would have after a shower of snow, being then almost white. The above characters have remained constant after the third time raised from seed on different soils *(i. e.)* on a light siliceous

Agrostis nivea.
Snowy Bent.

soil in Aspley Wood, where the trees had been thinned; on a heath soil, and on a clayey loam.

Experiments.—At the time of flowering, the produce from a sandy soil, incumbent on clay, is,

	dr.	qr.	oz.		lbs.		
Grass, 9 oz. The produce per acre			98010	0 =	6125	10	0
80 dr. of grass weigh, when dry	34	0	41654	4 =	2603	6	4
The produce of the space, ditto	61	$0\frac{4}{5}$					
The weight lost by the produce of one acre in drying			3522	3	12		
64 dr. of grass afford of nutritive matter	2	2	3828	8 =	239	4	8
The produce of the space, ditto	5	$2\frac{1}{2}$					
At the time the seed is ripe, the produce is,							
Grass, 7 oz. The produce per acre			76230	0 =	4764	6	0
80 dr. of grass weigh, when dry	22	0	20963	4 =	1310	3	4
The produce of the space, ditto	30	$3\frac{1}{5}$					
The weight lost by the produce of one acre in drying			3454	3	0		
64 dr. of grass afford of nutritive matter	2	0	2382	3 =	148	14	3
The produce of the space, ditto	3	$0\frac{1}{2}$					
The produce of latter-math is,							
Grass, 3 oz. The produce per acre			32670	0 =	2041	14	0
64 dr. of grass afford of nutritive matter	1	2	765	11 =	47	13	0
The weight of nutritive matter which is lost by leaving the crop till the seed be ripe, is,					90	6	5

The seeds of this grass, when sown on a heath soil, and on a clayey loam of equal space, afforded of grass, from the time they were sown, May 10, till the time the produce was collected, on the 20th of August following:

Heath soil, produce of grass	2 oz.
Clayey loam, produce of grass	1

On comparing the properties of this grass with those of the common bent, (*Agrostis vulgaris*), it will be found inferior in the proportion nearly of 5 to 3. It appears to be a very scarce grass: I have only seen it twice in a wild state, and then but in very small quantities. It grows on the east side of Aspley Wood, and by the side of a field near Wavendon.

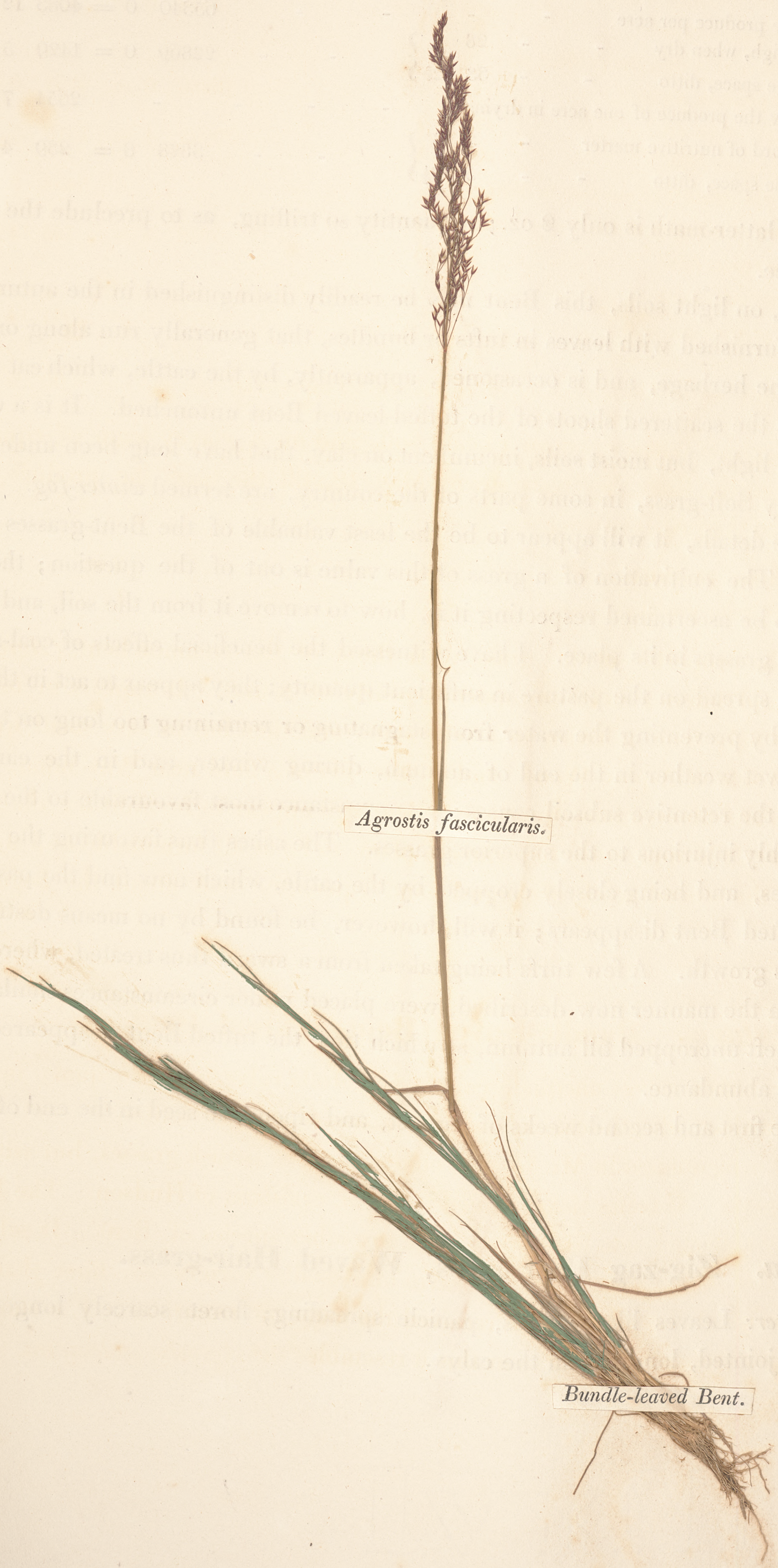
From these facts and observations, the Snowy Bent will appear to be unfit for the purposes of the Agriculturist. It is apparently too scarce a plant, to be at all formidable as a weed.

It flowers about the second week of August, and ripens the seed about the beginning of September.

Agrostis fascicularis. Bundle-leaved Bent, Tufted Bent.

Specific character: Calyx valves unequal, coloured; corolla valves very unequal; inner valve very minute, awnless; sheath-scale acuminate; leaves in dense bundles.

Obs.—This grass is mentioned in Mr. Curtis's enumeration of British grasses, but without any specific description. It seems nearly allied to the *A. capillaris* of Hudson. The leaves are more obviously collected into bundles than in any other species of Bent. It seldom rises to more than five inches in height: the leaves of a smaller variety are finer than those of most other species of Bent, and it has received the name of *tenuifolia.* The shoots strike root at the joints in moist situations; in this it resembles the *Agrostis stolonifera.*


Agrostis fascicularis.
Bundle-leaved Bent.

Experiments.— At the time of flowering, the produce from a sandy soil, is,

	dr.	qr.	oz.		lbs.		
Grass, 4 oz. The produce per acre - - - -			43560	0 =	2722	8	0
80 dr. of grass weigh, when dry - -	20	0	10890	0 =	680	10	0
The produce of the space, ditto - -	16	0					
The weight lost by the produce of one acre in drying - - - -					2041	14	0
64 dr. of grass afford of nutritive matter -	2	0	1361	4 =	85	1	4
The produce of the space, ditto - -	2	0					
At the time the seed is ripe, the produce is,							
Grass, 6 oz. The produce per acre - - - -			65340	0 =	4083	12	0
80 dr. of grass weigh, when dry - -	28	0	22869	0 =	1429	5	0
The produce of the space, ditto - -	33	$2\frac{2}{5}$					
The weight lost by the produce of one acre in drying - - - -					2654	7	0
64 dr. of grass afford of nutritive matter -	3	3	3828	8 =	239	4	0
The produce of the space, ditto - -	5	$2\frac{1}{2}$					

The produce of latter-math is only 2 oz.; a quantity so trifling, as to preclude the necessity of any farther notice.

In old pastures, on light soils, this Bent may be readily distinguished in the autumn by its shoots, which are furnished with leaves in tufts or bundles, that generally run along on the surface of the rest of the herbage, and is occasioned, apparently, by the cattle, which eat the other herbage, and leave the scattered shoots of the tufted-leaved Bent untouched. It is a very common grass on poor, light, but moist soils, incumbent on clay, that have long been under pasture. This and the Woolly Soft-grass, in some parts of the country, are termed *winter-fog*.

From the above details, it will appear to be the least valuable of the Bent-grasses that have been mentioned. The cultivation of a grass of this value is out of the question; the point of most importance to be ascertained respecting it is, how to remove it from the soil, and to substitute more valuable grasses in its place. I have witnessed the beneficial effects of coal-ashes as a top-dressing, when spread on the pasture in sufficient quantity; they appear to act in the manner of a surface-drain, by preventing the water from stagnating or remaining too long on the surface of the soil during wet weather in the end of autumn, during winter, and in the early part of the spring, which the retentive subsoil causes; a circumstance most favourable to the growth of this grass, but highly injurious to the superior grasses. The ashes thus favouring the growth of the superior grasses, and being closely cropped by the cattle, which now find the pasture more palatable, the tufted Bent disappears; it will, however, be found by no means destroyed, but only checked in its growth. A few turfs being taken from a sward thus treated, where the Bent had disappeared in the manner now described, were placed under circumstances similar to their former state, and left uncropped till autumn, at which time the tufted Bent re-appeared in all its former vigour and abundance.

Flowers in the first and second weeks of August, and ripens the seed in the end of the same month.

Aira flexuosa. Zig-zag Hair-grass, Waved Hair-grass.

Specific character: Leaves like bristles, panicle spreading; florets scarcely longer than the calyx; awn jointed, longer than the calyx.

Aira flexuosa.

Zig-zag Hair-grass.

Obs.—The culms and leaves grow in dense tufts; the panicle, before the time of flowering, is of a fine glossy purple colour; the blossom is woolly at the base, awn knee-bent, half as long as the blossom; calyx generally 2-flowered, rarely three; the inferior floret sitting. Flo. Ger. 257; Wither. Arr.; E. Bot. 1453; Host. t. 42; Flo. Dan. 240.

Native of Britain. Root fibrous, perennial.

Experiments.—At the time of flowering, the produce from a heath soil incumbent on clay, is,

	dr.	qr.		oz.		lbs.		
Grass, 15 oz. The produce per acre - - - - - -				163350	0 =	10209	6	0
80 dr. of grass weigh, when dry - -	26	0	- -	53088	12 =	3318	0	12
The produce of the space, ditto - -	78	0						
The weight lost by the produce of one acre in drying - - - -				6891	5	4		
64 dr. of grass afford of nutritive matter -	2	0	- -	5104	11 =	319	0	11
The produce of the space, ditto - -	7	2						
At the time the seed is ripe, the produce is,								
Grass, 14 oz. The produce per acre - - - - -				152460	0 =	9528	12	0
80 dr. of grass weigh, when dry - -	30	0	- -	57172	8 =	3573	4	8
The produce of the space, ditto - -	84	0						
The weight lost by the produce of one acre in drying - - - -				5955	8	0		
64 dr. of grass afford of nutritive matter -	2	0	- -	4764	6 =	297	12	6
The produce of the space, ditto - -	7	0						
The produce of latter-math is,								
Grass, 4 oz. The produce per acre - - - -				43560	0 =	2722	8	0
64 dr. of grass afford of nutritive matter -	1	3	- -	1191	0 =	74	7	0
The weight of nutritive matter which is lost by leaving the crop till the seed be ripe, is -						21	4	5

The proportional value in which grass, at the time of flowering, exceeds that of the latter-math, is as 8 to 7.

Two spaces of a heath soil and a clayey loam were sown with the seeds of this grass on the 20th of May, 1812; the seed vegetated well, and the produce was collected in the month of August following. It consisted of,

From the heath soil, grass 4 oz. which afforded of nutritive matter - -	60 grains.
From the clayey loam, grass 2 oz. which, in proportion, afforded of nutritive matter	56 grains.

From which it appears, that the produce of this grass, on a heath soil, is superior to that on a clayey loam, in the proportion of 2 to 1. An instance was brought forward under the subject of *Agrostis canina*, where the *Agrostis stolonifera* produced, the first year of sowing, one-third less of grass on a clayey soil than on a sandy soil; but in the succeeding years, the produce from the clayey loam tripled that from the sandy soil. With the Zig-zag Hair-grass the case is directly the reverse, for the produce of the clayey soil diminishes yearly, till the grass at length disappears altogether. I mention this, merely to shew the danger of drawing hasty conclusions from the experience of one or two seasons only.

The *Aira flexuosa* is much more productive on its natural soil than the *Festuca ovina;* but it requires a deeper soil, though not a richer. The *Festuca ovina* is more common among heath, *(Erica vulgaris);* the *Aira flexuosa* among furze, *(Ulex europæus);* though both grasses frequently grow intermixed on the same soil. To those who attempt the improvement of such

soils in a secondary manner only, this species of Hair-grass appears to be the best of those grasses natural to the soils in question, and may form a principal part of a mixture of seeds for that purpose of improvement.

Flowers in the first week of July. Seed ripens in August.

Poa Cenisia. Soft Meadow-grass.

Specific character: Panicle diffuse, nodding; spikets oblong 5-7 flowered; florets connected at the base by a villus; sheath-scale short; root fibrous. Flo. Ger. 422.

Obs.—This grass holds a place between the *Poa laxa* and *Poa alpina.* It differs from the first, to which it is nearest allied, in the culms being twice the height, and roundish towards the top; sheath-scale short; panicle diffuse, but always contracted before and after flowering; spikets larger, oblong 5-7 flowered. From the *Poa alpina* it differs also as above, but chiefly in the panicle, which is nodding, spikets oblong, and florets free.

Native of Germany. Root perennial. Flo. Ger.; Host. 3, p. 11, t. 16.

Experiments.—At the time of flowering, the produce from a sandy loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 10 oz. The produce per acre - - - -			108900	0 =	6806	4	0
80 dr. of grass weigh, when dry - -	22	0	29947	8 =	1871	11	8
The produce of the space, ditto - -	44	0					
The weight lost by the produce of one acre in drying - - - -			4934	8	8		
64 dr. of grass afford of nutritive matter -	2	1	3828	8 =	239	4	8
The produce of the space, ditto - -	5	2½					

This is an alpine species of grass, and attains to a greater size than most others of the same class; but it is a native of the Alps of the fertile duchy of Carinthia, in Germany. It is rather late in the produce of foliage in the spring, and does not afford much after-grass. Its nutritive powers, as indicated by the quantity of nutritive matter it contains, is not superior to several other grasses that afford a greater abundance of herbage throughout the season. It produces flowers about the first and second weeks of July, and seeds in the second week of August.

Poa cenisia.
Soft Meadow-grass.

Stipa pennata. Long-awned Feather-grass.

Generic character: Calyx 2-valved, 1-flowered; corolla outer valve ending in an awn; awn joined at the base.

Specific character: Awns woolly.

Obs.—Awns from six to twelve inches long or more, set with very fine, soft, white, pellucid hairs. In Ray's Synopsis, p. 393, this elegant grass is said to have been found by Dr. Richardson and Thomas Lawson, on the limestone rocks hanging over a little valley called Longsdale, about six miles north of Kendal, in Westmoreland. Hudson gives no other place of growth; but in the second edition of Withering's Botanical Arrangement of British Plants, Mr. Alderson is said to have found it near Kendal. Mr. Gough, who lives near Kendal, informs Dr. Withering, that he never could find, nor hear of its being found by any person except the two first-mentioned Gentlemen; there is therefore reason to fear that it may be exterminated. (Wither. Arr.)

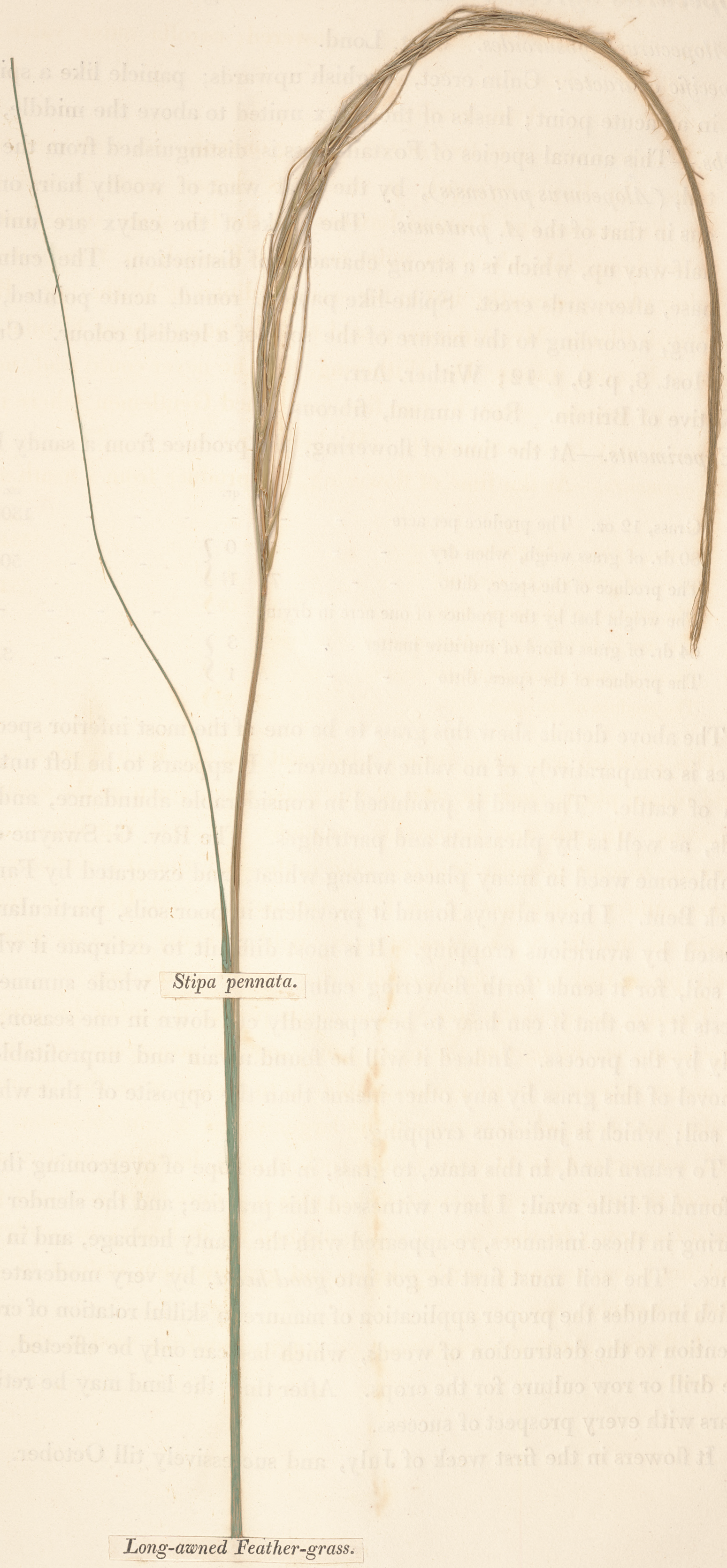
Experiments.—At the time of flowering, the produce from a heath soil, is,

	dr.	qr.	oz.		lbs.		
Grass, 14 oz. The produce per acre - - - -			152460	0 =	9528	12	0
80 dr. of grass weigh, when dry - -	29	0	- 55266	12 =	3454	2	12
The produce of the space, ditto - -	81	0½					
The weight lost by the produce of one acre in drying - - - - - -			6074	9	4		
64 dr. of grass afford of nutritive matter -	2	3	- - 6551	0 =	409	7	0
The produce of the space, ditto - -	9	2½					

This produce was taken from a heath soil that had been *planted* with the grass; for I never could obtain plants from the seed of this grass when sown in the ordinary way on soils in open situations. In pots and favourable situations, the seeds vegetated very well; it may probably be owing to some peculiarity of this kind in the seed, that it is not now to be found in a wild state in this country. Schrader, in his Flora Germanica, and Host, in his Gramina Austriacorum, inform us, that the *Stipa pennata* grows wild in many parts of Germany, on alpine, or dry sandy places that are much exposed to the warmth of the sun.

Though, as far as the above experiments prove, it cannot be propagated by the seed on a large scale, yet by parting the roots it may soon be propagated to any extent; but its agricultural merits appear to be so inconsiderable, as to rank it with the inferior grasses. The beautiful feather-like awns which terminate the larger valves of the blossom, and which adhere to the seed, serving as a sail to waft it from rock to rock, have procured it a place in the flower-gardens of the curious, and serve to distinguish it at once from all other grasses. Johnson, the editor of Gerarde's Herbal, says it was nourished for its beauty in sundry of our English gardens; and that it was worn by sundry ladies and gentlewomen instead of a feather, which it exquisitely resembles, &c.

It flowers about the beginning of August, and the seed is ripe about the middle of September.



Stipa pennata.

Long-awned Feather-grass.

Alopecurus agrestis. Slender Foxtail-grass.

Alopecurus myosuroides. Curt. Lond.

Specific character: Culm erect, roughish upwards; panicle like a spike, cylindric, but ending in an acute point; husks of the calyx united to above the middle, acute, naked.

Obs.—This annual species of Foxtail-grass is distinguished from the perennial meadow fox-tail, *(Alopecurus pratensis)*, by the total want of woolly hairs on the spike, so conspicuous in that of the *A. pratensis.* The husks of the calyx are united at the bottom, and half-way up, which is a strong character of distinction. The culms are ascending at the base, afterwards erect. Spike-like panicle, round, acute pointed, from two to four inches long, according to the nature of the soil; of a leadish colour. Curt. Lond.; E. Bot. 848; Host. 3, p. 9, t. 12; Wither. Arr.

Native of Britain. Root annual, fibrous.

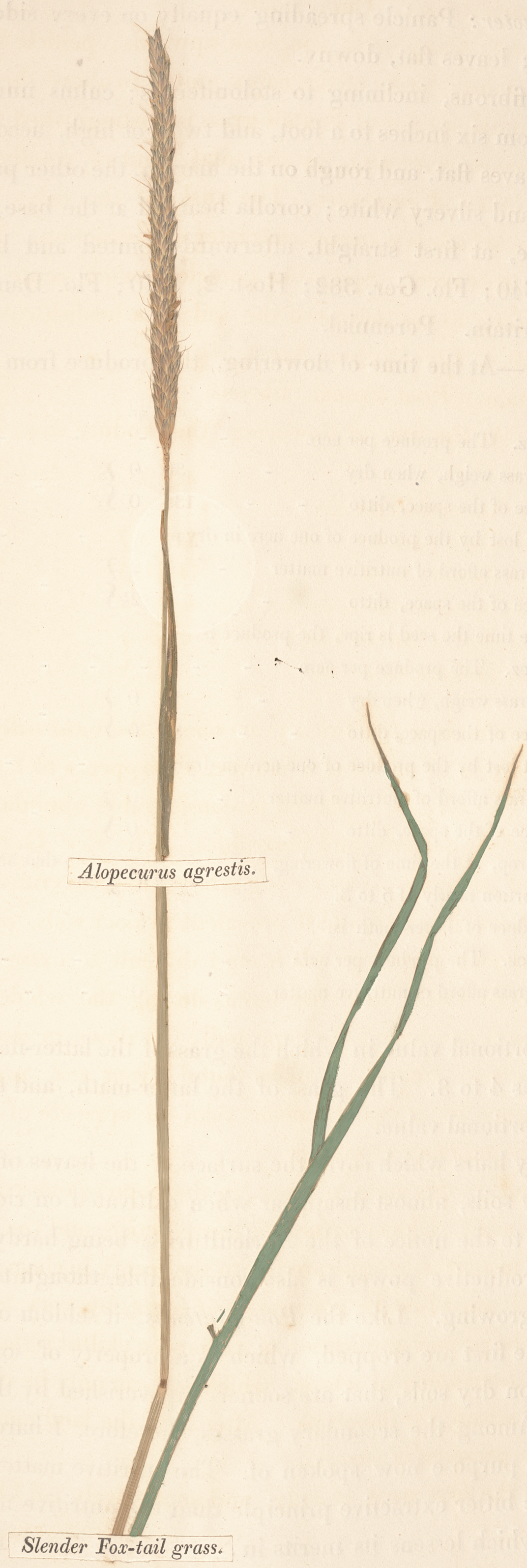
Experiments.—At the time of flowering, the produce from a sandy loam, is,

	dr.	qr.		oz.		lbs.		
Grass, 12 oz. The produce per acre - - - - - - - -				130680	0 =	8167	8	0
80 dr. of grass weigh, when dry - -	31	0	- -	50638	8 =	3164	14	8
The produce of the space, ditto - -	74	$1\frac{3}{5}$						
The weight lost by the produce of one acre in drying - - - - - - - -				5002	9	8		
64 dr. of grass afford of nutritive matter -	1	3	- - -	3573	4 =	223	5	4
The produce of the space, ditto - -	5	1						

The above details shew this grass to be one of the most inferior species. The herbage it produces is comparatively of no value whatever. It appears to be left untouched by every description of cattle. The seed is produced in considerable abundance, and is eaten by the smaller birds, as well as by pheasants and partridges. The Rev. G. Swayne observes, that it is a very troublesome weed in many places among wheat, and execrated by Farmers, under the name of Black Bent. I have always found it prevalent in poor soils, particularly such as had been exhausted by avaricious cropping. It is most difficult to extirpate it when once in possession of the soil, for it sends forth flowering culms during the whole summer and autumn, till frost arrests it; so that it can bear to be repeatedly cut down in one season, without suffering essentially by the process. Indeed it will be found a vain and unprofitable labour to attempt the removal of this grass by any other means than the opposite of that which gave it possession of the soil; which is judicious cropping.

To return land, in this state, to grass, in the hope of overcoming this unprofitable plant, will be found of little avail: I have witnessed this practice; and the slender Fox-tail, instead of disappearing in these instances, re-appeared with the scanty herbage, and in greater health and abundance. The soil must first be got into *good heart*, by very moderate and judicious cropping, which includes the proper application of manure, a skilful rotation of crops, and the most pointed attention to the destruction of weeds, which last can only be effected, in this sense, by adopting the drill or row culture for the crops. After this, the land may be returned to grass for several years with every prospect of success.

It flowers in the first week of July, and successively till October.



Alopecurus agrestis.

Slender Fox-tail grass.

Avena pubescens. Downy Oat-grass.

Specific character: Panicle spreading equally on every side; calyx 3-flowered, shorter than the florets; leaves flat, downy.

Obs.—Root fibrous, inclining to stoloniferous; culms numerous, erect, roundish, striated, smooth, from six inches to a foot, and two feet high, according to the nature of the soil and shelter; leaves flat, and rough on the margin, the other parts soft, with downy hairs; florets purplish, and silvery white; corolla bearded at the base, larger valve with an awn fixed at the middle, at first straight, afterwards jointed and bent back, longer than the valve. E. Bot. 1640; Flo. Ger. 382; Host. 2, t. 40; Flo. Dan. t. 1203; Wither. Arr.

Native of Britain. Perennial.

Experiments.—At the time of flowering, the produce from a sandy soil, is,

	dr.	qr.		oz.		lbs.		
Grass, 23 oz. The produce per acre	-	-	- -	250470	0 =	15654	6	0
80 dr. of grass weigh, when dry	30	0	- -	93926	4 =	5870	6	4
The produce of the space, ditto	138	0						
The weight lost by the produce of one acre in drying			- - - -			9783	15	12
64 dr. of grass afford of nutritive matter	1	2	- -	5870	6 =	366	14	6
The produce of the space, ditto	8	2⅛						

At the time the seed is ripe, the produce is,

Grass, 10 oz. The produce per acre			- - - - - -	108900	0 =	6806	4	0
80 dr. of grass weigh, when dry	16	0	- -	21780	0 =	1361	4	0
The produce of the space, ditto	32	0						
The weight lost by the produce of one acre in drying			- - - -			5445	0	0
64 dr. of grass afford of nutritive matter	2	0	- -	3403	2 =	212	11	2
The produce of the space, ditto	5	0						

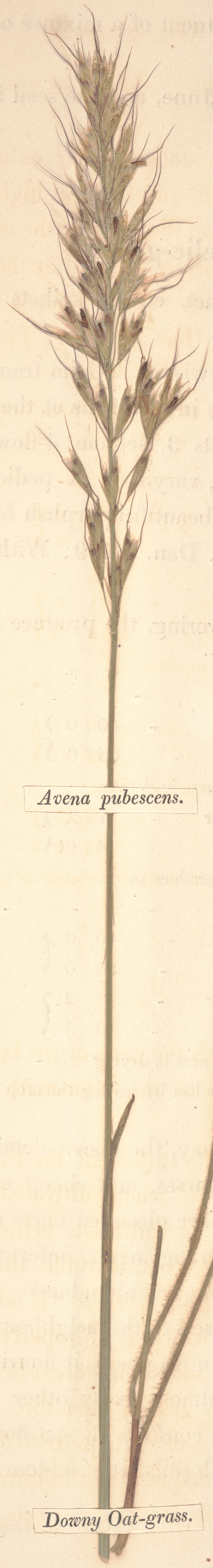
The crop, at the time of flowering, is therefore superior to that at the time the seed is ripe, in the proportion nearly of 5 to 3.

The produce of latter-math is,

Grass, 10 oz. The produce per acre			- - - -	108900	0 =	6806	4	0
64 dr. of grass afford of nutritive matter	2	0	- - -	3403	2 =	212	11	2

The proportional value in which the grass of the latter-math is inferior to that at the time of flowering, is as 4 to 3. The grass of the latter-math, and that at the time the seed is ripe, are of equal proportional value.

The downy hairs which cover the surface of the leaves of this grass when growing on poor, dry, or chalky soils, almost disappear when cultivated on richer soils. It has properties which recommend it to the notice of the Agriculturist, being hardy, and a small impoverisher of the soil; the reproductive power is also considerable, though the foliage does not attain to a great length if left growing. Like the *Poa pratensis*, it seldom or never sends forth any flowering culms after the first are cropped, which is a property of some value for the purpose of permanent pasture on dry soils, that are sooner impoverished by the growth of plants than those that are moist. Among the secondary grasses, therefore, I hardly know one whose habits promise better for the purpose now spoken of. The nutritive matter it affords, contains a greater proportion of the bitter extractive principle than the nutritive matter of those grasses that affect a similar soil, which lessens its merits in those respects, and must prevent its being employed in



Avena pubescens.

Downy Oat-grass.

any considerable quantity, as a constituent of a mixture of grasses for laying down such soils to grass.

It flowers in the second week of June, and the seed is ripe about the beginning or in the middle of July.

Melica cærulea. Purple Melic-grass.

Specific character: Panicle compact, equal; spikets erect, oblong-cylindrical; culms with one joint, very rarely two.

Obs.—Root fibrous, tough, often twisted. Culm from six inches to two feet high, according to the depth of the soil it grows in; bulbous at the base, with one joint. Leaves linear, acuminated, channeled. Spikets 3, seldom 4-flowered, of a green and purple, or of a green, violet, and purple colour, varying. A pedicle knobbed at the end rises from betwixt the florets. Anthers of a beautiful purplish blue colour, pistil purple. E. Bot. 750; Flo. Ger. 269; Host. t. 8; Flo. Dan. t. 239; Wither. Arr.

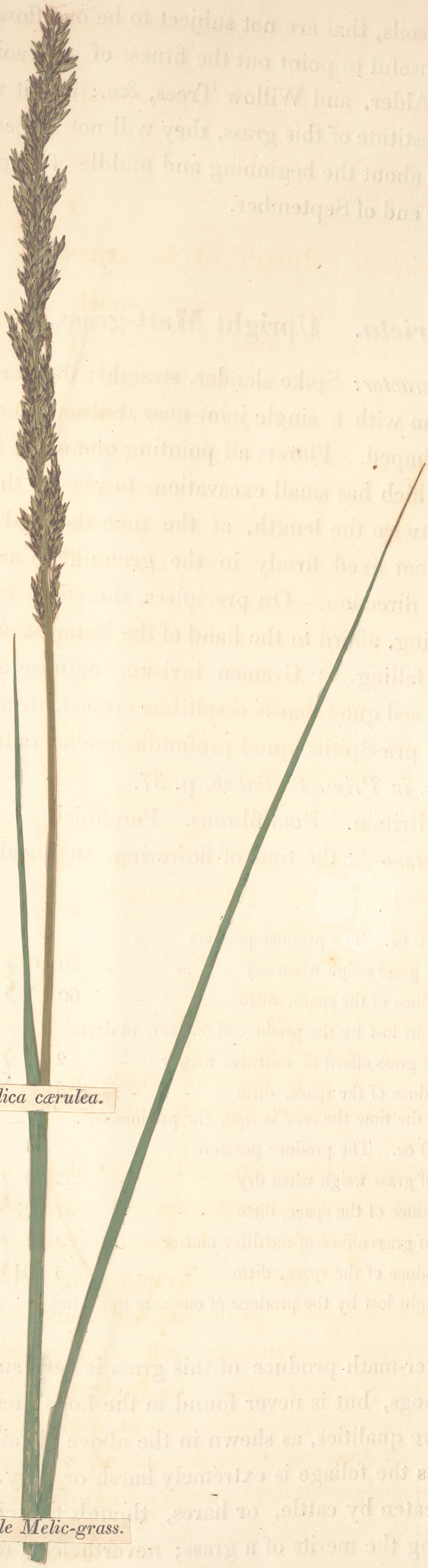
Native of Britain. Perennial.

Experiments.—At the time of flowering, the produce from a light sandy soil, is,

	dr.	qr.		oz.		lbs.		
Grass, 11 oz. The produce per acre - -				119790	0 =	7486	14	0
80 dr. of grass weigh, when dry - -	30	0	- -	44921	4 =	2807	9	4
The produce of the space, ditto - -	66	0						
The weight lost by the produce of one acre in drying - - - -				4679	4	12		
64 dr. of grass afford of nutritive matter -	1	2	- -	2807	9 =	175	0	9
The produce of the space, ditto - -	4	0¾						
At the time the seed is ripe, the produce is,								
Grass, 10 oz. The produce per acre - - - -				108900	0 =	6806	4	0
80 dr. of grass weigh, when dry - -	40	0	- -	54450	0 =	3403	2	0
The produce of the space, ditto - -	80	0						
64 dr. of grass afford of nutritive matter -	1	2	- -	2552	5 =	159	8	5
The produce of the space, ditto - -	3	3						
The weight lost by the produce of one acre in drying - - - - - -				3403	2	0		
The weight of nutritive matter which is lost by leaving the crop till the seed be ripe, is -				15	8	4		

For the purposes of pasture, or hay, the above details shew this grass to be comparatively of no value. It is said that goats, horses, and sheep eat it: I have laid it before cows and sheep, but they turned from it: I have observed hares to crop the foliage in the spring. The Rev. G. Swayne, in Withering's Arrangements, informs us, that in the turf moors below Glastonsbury, Somersetshire, it grows in great abundance. The country people make of the straws a neat kind of besoms, which they sell to the neighbouring inhabitants, as a cheap and no despicable substitute for hair brooms. In Anglesea, it flourishes in the neighbourhood of the copper works of Pary's mountain, while almost every other vegetable, even lichens, are injured or destroyed*. In deep sands, on the confines of peat-bogs, this grass is frequent; also from sand banks, under hedges enclosing heath soils, it is seldom absent. It grows to the greatest height

* Withering's Arrangements.



Melica cærulea.

Purple Melic-grass.

on deep peat soils, that are not subject to be overflown, but dry for the most part of the year. This grass is useful to point out the fitness of such soils as that last mentioned, for the production of Ash, Alder, and Willow Trees, &c.; and it will be found, that on such parts of the peat as are destitute of this grass, they will not succeed so well, if at all.

It flowers about the beginning and middle of August, and the seed is ripe towards the middle and latter end of September.

Nardus stricta. Upright Matt-grass.

Specific character: Spike slender, straight; the florets pointing in one direction. E. Bot. 290.

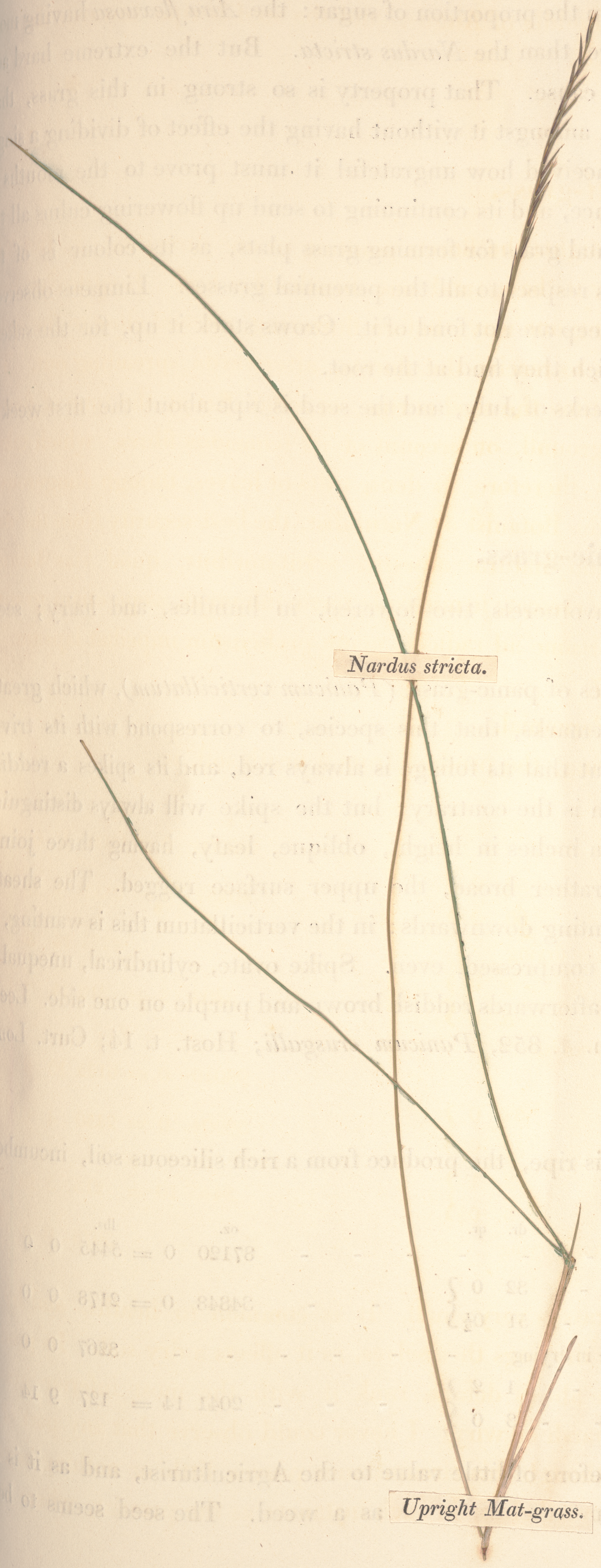
Obs.—Culm with a single joint near its base, and one bristle-like leaf. Root-leaves long, thread-shaped. Florets all pointing one way; before flowering, pressed close to the spike-stalk, which has small excavations to receive the florets, afterwards spreading out. The culm is twice the length, at the time the seed is ripe, of what it is at the time of flowering. Root fixed firmly in the ground, on account of its tenacious fibres, which take a flexuose direction. On precipices, therefore, its dense tufts of leaves, though dangerous to the footing, afford to the hand of the Botanist or Naturalist, the best security from the danger of falling. "Gramen invisum naturæ alpestris scrutatoribus, quod vias lubricas reddat; sed quod densis cespitibus crescat, firmiterque terræ inhæreat, sæpe etiam gratissimum in præcipitiis, quod profundissime ad radicem manu prehensum impediat lapsum."—*Schrank. in Prim. Fl. Salisb.* p. 37.

Native of Britain. Root fibrous. Perennial.

Experiments.—At the time of flowering, the produce from a heath soil, is,

	dr.	qr.	oz.		lbs.		
Grass, 10 oz. The produce per acre			108900	0 =	6806	4	0
80 dr. of grass weigh when dry	30	0	40837	8 =	2552	5	8
The produce of the space, ditto	60	0					
The weight lost by the produce of one acre in drying					4253	14	8
64 dr. of grass afford of nutritive matter	2	0	3403	2 =	212	11	2
The produce of the space, ditto	5	0					
At the time the seed is ripe, the produce is,							
Grass, 9 oz. The produce per acre			98010	0 =	6125	10	0
80 dr. of grass weigh when dry	32	0	39204	0 =	2450	4	0
The produce of the space, ditto	57	$2\frac{2}{5}$					
64 dr. of grass afford of nutritive matter	2	1	3445	10 =	215	5	10
The produce of the space, ditto	5	$0\frac{1}{4}$					
The weight lost by the produce of one acre in drying					3675	6	0

The latter-math produce of this grass is very small. It is common to heaths, and by the margin of bogs, but is never found in the bogs themselves, as it affects a dry soil. Its produce and nutritive qualities, as shewn in the above details, rank it with the most inferior grasses, especially as the foliage is extremely harsh or wiry. I never could observe that any part of the plant was eaten by cattle, or hares, though this circumstance proves little or nothing in general regarding the merits of a grass; nevertheless, in such instances as the present, where there



Nardus stricta.

Upright Mat-grass.

are few grasses besides for animals to select, the rejection or neglect of a grass, must proceed more from some radical defect in the plant for the purpose of food, than from caprice or satiety in the animal. The nutritive matter offers no reason for this dislike manifested by animals for the grass, as its composition is much the same as that of the *Aira flexuosa*, which is eaten with relish by sheep; the only difference is in the proportion of sugar: the *Aira flexuosa* having more of this constituent, and less of mucilage, than the *Nardus stricta*. But the extreme hard and wiry nature of the foliage explains the cause. That property is so strong in this grass, that, in the ordinary way, a scythe is passed amongst it without having the effect of dividing a single leaf; and from this it may easily be conceived how ungrateful it must prove to the mouths of cattle. Were it not for this circumstance, and its continuing to send up flowering culms all the summer, it would be the most ornamental grass for forming grass plats, as its colour is of the finest dark green, being superior in this respect to all the perennial grasses. Linnæus observes, that goats and horses eat it; and that sheep are not fond of it. Crows stock it up, for the sake of the larvæ of some species of tipulæ which they find at the root.

It flowers in the first and second weeks of July, and the seed is ripe about the first week of August.

Panicum viride. Green Panic-grass.

Specific character: Spike round, involucrets two-flowered, in bundles, and hairy; seeds nerved.

Obs.—There is another annual species of panic-grass, *(Panicum verticillatum)*, which greatly resembles this one. Mr. Curtis remarks, that this species, to correspond with its trivial name, should be always green, but that its foliage is always red, and its spikes a reddish brown, and that the verticillatum is the contrary; but the spike will always distinguish them. Culms from four to sixteen inches in height, oblique, leafy, having three joints, striated at top, rugged; leaves rather broad, the upper surface rugged. The sheath-scale consists of a row of hairs pointing downwards: in the verticillatum this is wanting, or very minute. Sheaths somewhat compressed, even. Spike ovate, cylindrical, unequal in thickness, green before flowering, afterwards reddish brown and purple on one side. Leers. Martyn; E. Bot. 875; Flo. Dan. t. 852, *Panicum crusgalli;* Host. t. 14; Curt. Lond. fasc. 44.

Native of Britain. Root annual.

Experiments.—At the time the seed is ripe, the produce from a rich siliceous soil, incumbent on clay, is,

	dr.	qr.	oz.		lbs.		
Grass, 8 oz. The produce per acre - - - - - - - -			87120	0 =	5445	0	0
80 dr. of grass weigh, when dry - -	32	0					
The produce of the space, ditto - -	51	0½	34848	0 =	2178	0	0
The weight lost by the produce of one acre in drying - - - - - - - -			3267	0	0		
64 dr. of grass afford of nutritive matter -	1	2					
The produce of the space, ditto - - -	3	0	2041	14 =	127	9	14

This species of Panic-grass is therefore of little value to the Agriculturist, and as it is far from being a common grass, it is not much to be feared as a weed. The seed seems to be a

Panicum viride.

Green Panic-grass.

favourite food of birds, particularly of the smaller species; unless care is taken before the seed is perfected and collected, little will be saved from these depredators. The seeds vegetate better when sown in June, or as soon as they are ripe in the autumn, than in any other season. It is natural to sandy soils, but maintains itself likewise on damp clayey soils without any culture, except that of preventing it from being overpowered by other plants. The annual grasses that afford but small quantities of nutritive matter, and an inferior weight of herbage, impoverish the soil very little, as the *Panicum viride, Panicum sanguinale, Festuca myurus, Bromus mollis,* &c. for this reason they are raised naturally on the same spot for a series of years, without much diminution in the yearly produce. There are three spots of ground in the Grass-garden at Woburn, of which the three first mentioned species have kept possession in this manner for five years: no manure had been applied, the ground was merely *pointed* over in the spring, and kept free of weeds during the season; the seed which was naturally shed by the plants was sufficient. But with respect to the annual grasses that afforded a much greater proportion of nutritive matter, the case proved very different, as the *Bromus arvensis, Phalaris canariensis, Lolium temulentum,* and others, hardly afforded half the usual produce the second year of cultivation, on the same spot, though manure was applied.

It flowers in the second and third weeks of July, when sown in the preceding autumn, and the seed is ripe about the middle of August; but it continues to flower till the cold prevents it.

Panicum sanguinale. Slender-spiked Panic-grass.

Syntherisma vulgare. (Schrader.)

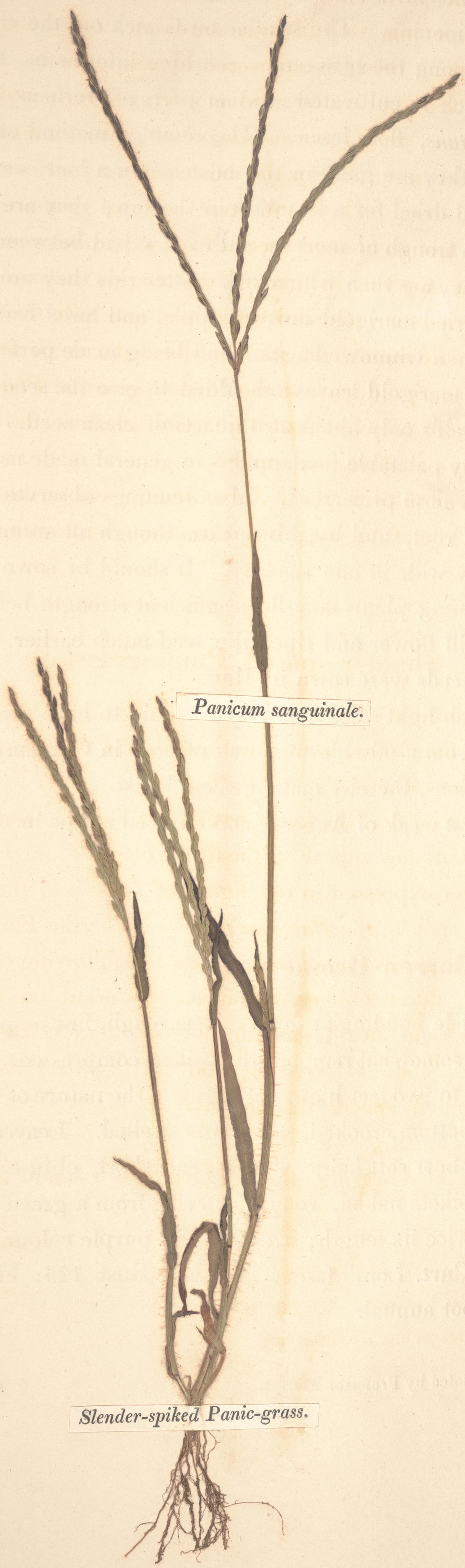
Specific character: Spikets finger-like, knotty on the inside of the base; florets in pairs, without awns; sheaths of the leaves dotted.

Obs.—Dr. Withering observes, that the knots within the base of the spikets, and the dots on the sheaths of the leaves, do not appear on the figure of the Flora Lond.; but the former is mentioned, and the latter expressed in the figure of Leers; so that a doubt still remains, whether this plant may not be the *Panicum filiforme.* In the Flora Germanica these two species are referred to the genus *syntherisma,* under the following characters: "Leaves and sheaths somewhat hairy, florets oblong, somewhat pubescent on the margin. *P. sanguinale,* E. Bot."—"Leaves and sheaths smooth, florets ovate. *Syntherisma glabrum.*"—*Panicum sanguinale* of Leers, above referred to; and the *Digitaria filiformis,* in Koel. Gram. These appear to be excellent specific distinctions.

Native of Britain. Root annual.

Experiments.—At the time of flowering, the produce from a sandy soil, is,

	dr.	qr.	oz.		lbs.		
Grass, 10 oz. The produce per acre - - - -			108900	0 =	6806	4	0
80 dr. of grass weigh, when dry -	30	0					
The produce of the space, ditto - -	60	0	40837	8 =	2552	5	8
The weight lost by the produce of one acre in drying - - - -			4253	14	8		
64 dr. of grass afford of nutritive matter -	1	$0\frac{1}{8}$					
The produce of the space, ditto - -	2	$2\frac{5}{16}$	1914	4 =	119	10	4



Panicum sanguinale.

Slender-spiked Panic-grass.

This and the foregoing species are strictly annual plants. From the above details, the nutritive powers of the herbage they produce is very inconsiderable. The *Panicum sanguinale* produces much seed, of which birds are very fond, and requires to be protected by nets, or otherwise, during the time of ripening. The smaller birds pick out the ripe seed, even when only a small quantity is formed among the blossoms. Schreber informs us, the seeds are not only collected from this grass, which is cultivated in some parts of Germany for the purpose, but likewise from the *Festuca fluitans*, flote fescue. The common method of collecting and preparing them is this: At sun-rise they are gathered or beaten into a hair sieve from the dewy grass; are spread on a sheet, and dried for a fortnight in the sun; they are then gently beaten with a wooden pestle in a wooden trough or mortar, with straw laid between the seeds and the pestle, till the chaff comes off; they are then winnowed. After this they are again put into the trough or mortar, in rows, with dried marigold flowers, apple, and hazel leaves, and pounded till they appear bright; they are then winnowed again, and being made perfectly clean by this last process, are fit for use. The marigold leaves are added to give the seed a finer colour. A bushel of seed with the chaff, yields only about two quarts of clean seed. When boiled with milk or wine, it forms an extremely palatable food, and is in general made use of whole, in the manner of sago, to which it is in general preferred*. Miss Jennings observes, that all the stems that lie nearest the ground strike root, and by this means, though an annual and short-lived plant, it increases and spreads very wide in one season†. It should be sown as soon as the seed is ripe in the autumn, that the young plants may have sufficient strength before the winter begins; by this mode of culture, it will flower and ripen the seed much earlier than the time specified below; in that instance the seeds were sown in May.

It delights most in a rich light siliceous soil. It is said to have received the name *sanguinale*, not from its colour, but from a mischievous trick of boys in Germany, thrusting the spikets up the noses of their companions, thereby making them bleed.

It flowers about the first week of August, and the seed is ripe in the middle of September.

Bromus sterilis. Barren Brome-grass.

Specific character: Panicle nodding at top; spikets rough, linear-spear shaped. After flowering, the florets stand somewhat remote; the spikets compressed, broad upwards, awned.

Obs.— Culms from one to two feet high, according to the nature of the soil; upright, roundish and smooth, at the bottom crooked, the joints swelled. Leaves flat, both they and the culms covered with short soft hairs; sheath scale short, obtuse. Panicle large, nodding, half a foot long. Spikets naked, rough, varying from a green to a purple colour, larger valve with an awn twice its length; straight, of a purple colour towards the top. E. Bot. 1030; Host. t. 16; Curt. Lond. fasc. 4; Mart. F. Rust. 125; Flo. Ger. 364; Wither. Arr. Native of Britain. Root annual.

* As quoted by Professor Martyn.

† Withering.

Bromus sterilis.

Barren Brome-grass.

Experiments.—At the time of flowering, the produce from a sandy soil, is,

	dr.	qr.		oz.		lbs.		
Grass, 44 oz. The produce per acre - - - - -				479160	0 =	29947	8	0
80 dr. of grass weigh when dry - -	45	0	- -	269527	8 =	16845	7	8
The produce of the space, ditto - -	396	0						
The weight lost by the produce of one acre in drying - - - -						13102	0	8
64 dr. of grass afford of nutritive matter -	5	0	- -	37434	6 =	2339	10	6
The produce of the space, ditto - -	55	0						

It has been asserted, that the seeds of this grass seldom arrive at maturity, but there is hardly a grass, either in a natural or cultivated state, that ripens more seed than the Barren Brome-grass. Mr. Curtis affirms, that it acquired the name *sterilis,* or barren, from its inutility with respect to cattle, which appears most probable. Ray calls it Great Wild Oat-grass, or Drank.

The produce, as stated above, will appear great when compared to the appearance of the grass when growing; it is owing, however, to the large size of the panicle and spikets, which constitute the greater proportion of the weight of produce. This circumstance induced me to submit the given weight of the flowering panicles to experiment; the result was, that 64 dr. of the flowering panicles afforded 2 dr. 2 qr. of nutritive matter. The nutritive powers of the culms and leaves, conjunctly, are therefore twice as great as those of the flowering panicles. When the seed is perfected, the nutritive matter contained in the culms and leaves is comparatively nothing. The long sharp awns with which the spikets are armed, must prevent cattle from eating it. It grows chiefly under hedges, and on banks by the road-sides, where it is very common; but it is seldom found beyond the reach of the shade. I never could observe that any of it had been touched by cattle. When mown before the time of flowering, it is less disposed to send up secondary shoots from the roots than most other of the annual grasses, and may therefore be overcome by one or two mowings in the season; but its local place of growth prevents it from being troublesome, as a weed, in the field.

It flowers in the first and second weeks of July, and the seed is ripe about the beginning and middle of August.

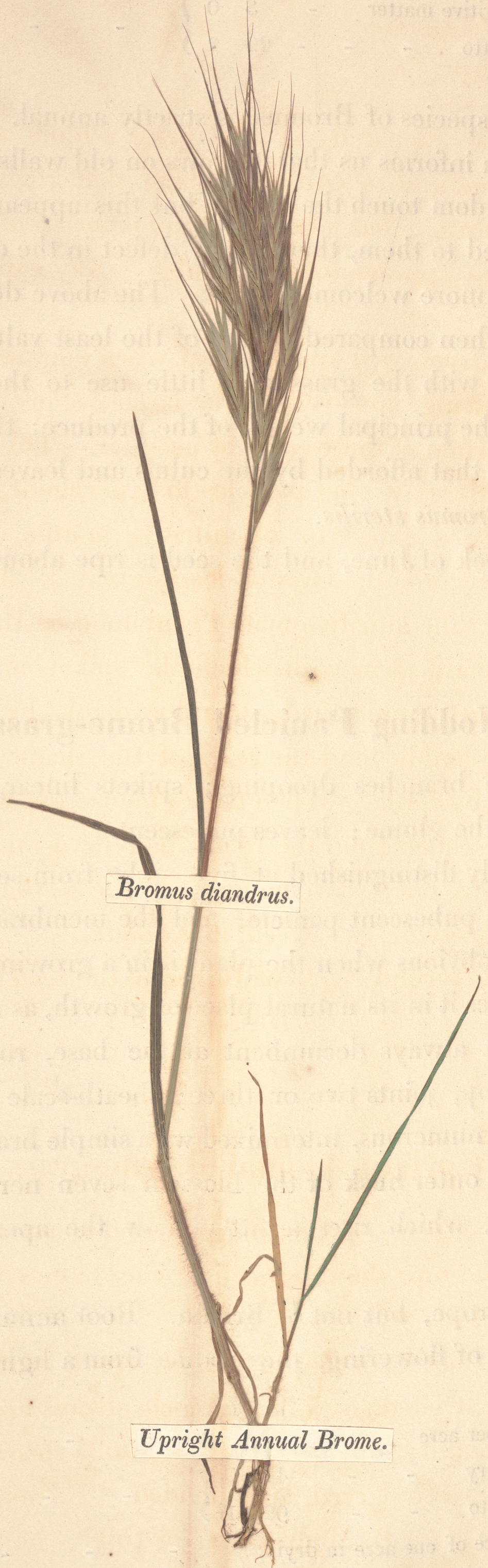
Bromus diandrus. Upright Annual Brome-grass.

Specific character: Panicle erect; spikets rough, linear-spear shaped, somewhat compressed, and becoming broader at top; the intermediate ones in pairs; awn straight, longer than the husk; leaves almost naked.

Obs.—Culms from half a foot to a foot in height, erect, but somewhat procumbent at the base, round, scored or striated, smooth. Panicle always erect; at first compact, afterwards spreading. Spikets straight; outer valve of the corolla spear-acuminate, a little compressed, margin membraneous, seven nerved, apex divided. E. Bot. 1006; Curt. Lond. fasc. 70; Host. t. 17; Flo. Ger. 366; B. Madritensis.

Festuca avenacea sterilis pediculis brevioribus et spicis erectis. Moris, s. 8, t. 7, f. 13.

Native of Britain. Root annual.



Bromus diandrus.

Upright Annual Brome.

Experiments.—At the time of flowering, the produce from a rich brown loam, is,

	dr.	qr.		oz.		lbs.		
Grass, 30 oz. The produce per acre	-	-	-	326700	0 =	20418	12	0
80 dr. of grass weigh, when dry	34	0	-	138847	8 =	8677	15	8
The produce of the space, ditto	204	0						
The weight lost by the produce of one acre in drying			-	11740	12	8		
64 dr. of grass afford of nutritive matter	3	0	-	15314	1 =	957	2	1
The produce of the space, ditto	22	2						

This, like the preceding species of Bromus, is strictly annual. It is much less common than the *Bromus sterilis:* Hudson informs us that it grows on old walls in the neighbourhood of London and Oxford. Birds seldom touch the seeds; but this appears to be more owing to the season in which it is presented to them, than to any defect in the quality of the seed; as there is then a profusion of food of a more welcome nature. The above details shew the produce of this grass, in one year, which, when compared to that of the least valuable of the perennial grasses, proves inferior, and ranks it with the grasses of little use to the Agriculturist. The panicle, when in flower, constitutes the principal weight of the produce: the nutritive matter it contains, bears a similar proportion to that afforded by the culms and leaves conjunctly, as was shewn to exist between those of the *Bromus sterilis.*

It flowers in the third week of June, and the seed is ripe about the middle and latter end of July.

Bromus tectorum. Nodding Panicled Brome-grass.

Specific character: Panicle branches drooping; spikets linear, pubescent; florets distant, awned, awn as long as the glume; leaves pubescent.

Obs.—This species is readily distinguished at first sight from several of the annual species of *Bromus,* by its drooping pubescent panicle; and the membraneous silver-like edges of the husks, which are more obvious when the plant is in a growing state, than in a dried specimen. Schrader describes it in its natural place of growth, as attaining the height of twelve inches; culm erect, but always decumbent at the base, round, striated, smooth, often pubescent towards the top, joints two or three; sheath-scale short, obtuse, always lacerated; panicle branches numerous, intermixed with simple branches, thread-shaped, always more or less pubescent; outer husk of the blossom seven nerved, the intermediate nerve terminating in an awn, which rises a little below the apex. Flo. Ger. 363; Host. i. p. 13, t. 15.

Native of most parts of Europe, but not of Britain. Root annual. Martyn.

Experiments.—At the time of flowering, the produce from a light sandy soil, is,

	dr.	qr.		oz.		lbs.		
Grass, 11 oz. The produce per acre	-	-	-	119790	0 =	7486	14	0
80 dr. of grass weigh, when dry	42	0	-	62889	12 =	3930	9	12
The produce of the space, ditto	92	$1\frac{3}{5}$						
The weight lost by the produce of one acre in drying			-	3556	4	4		
64 dr. of grass afford of nutritive matter	3	0	-	5615	2 =	350	15	2
The produce of the space, ditto	8	1						

Bromus tectorum.

Nodding panicled Brome.

This is another of the Annual Bromes, which is comparatively of no value. Dambourney, indeed, says, that at the time it approaches to a state of maturity, it may be useful in dying*, when it can be collected in sufficient quantity. Birds are fond of the seed, and the plants require protection before the seed be perfected, in order to secure a sufficient supply for the next year's sowing.

It may be remarked from the facts that have been brought forward respecting the Annual Bromes, that most of them, comparatively, afford more nutritive matter at the time they are in flower, than some of the best perennial grasses at the same stage of growth. The reason of this appears, on considering that the whole of the nutritive matter which is accumulated in one year by these annuals, is present in the plant at this period or shortly after, for when the seed is ripe, the straws contain but a small proportion of nutritive matter; and the seed itself contains little more than the plants afforded at the time of flowering, the difference being as 7 to 5, which seems to prove that the culms and leaves, a little after the time of flowering, contain nearly all the nutritive matter which passes into or constitutes the substance of the seed. It must be observed, that the produce of two square feet of soil was submitted to experiment at the time of flowering, and the seed produced on the same space of ground, was the quantity made use of in the same experiments, and which gave the above proportion. Most of the perennial grasses have very small seed, and the culms in general are succulent at the time the seed is perfected, which is not the case with the annual species. If the seeds, however, of the perennial grasses are suffered to remain a little while after they are ripe, the culms very soon become dry. The different degrees of this property in grasses, may be ascertained in some measure, by a comparison of the quantities of nutritive matter which they severally afford at the time the seed is ripe, as already stated in the foregoing details.

It flowers in the third week of June, and the seed is ripe about the end of July.

Agrostis capillaris. Fine-panicled Bent.

Specific character: Panicle hair-like, spreading, flexuose, calyxes subulate, equal, smooth, coloured. Wither. 74? Huds. Angl. 32.?

Obs.—Culm ascending, from six to twelve inches high, round, very smooth, with three or four joints; leaves very narrow, sheathing the straw for some length; sheath-scale membranaceous, acuminate; panicle upright, branches hair-like, somewhat flexuose; valves of the calyx nearly equal, ovate-lanceolate, concave, bluntish.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a sandy loam, is,

	dr.	qr.	oz.		lbs.	
Grass, 7 oz. The produce per acre - - - - - - -			76230	0 =	4764	6
80 dr. of grass weigh, when dry - -	22	0				
The produce of the space, ditto - -	30	$3\frac{1}{5}$	20963	4 =	1310	3
The weight lost by the produce of one acre in drying - - - -			3454	3		
64 dr. of grass afford of nutritive matter -	2	0				
The produce of the space, ditto - -	3	2	2382	3 =	148	14

* Recueil de procedés et d'experiences sur les teintures solides, &c. par M. L. A. Dambourney, Negociant à Rouen. Par. 1786-8.

Agrostis capillaris.

Fine panicled Bent.

The above details afford no proofs of the value of this for agricultural purposes. It is found in a wild state on heaths chiefly. I never observed that even hares cropped its herbage. Its manner of growth is similar to that of the *Agrostis fascicularis,* only that the leaves are not produced in bundles or tufts, which is so distinguishing a feature of that grass. It is seldom combined with any other species of grass, but grows in detached patches on moors and heaths.

It flowers in the beginning of August, and the seed is ripe about the end of that month.

Alopecurus bulbosus geniculatus. Bulbous-rooted knee-jointed Foxtail-grass.

Specific character: Flowers in a spike, culm knee-jointed.

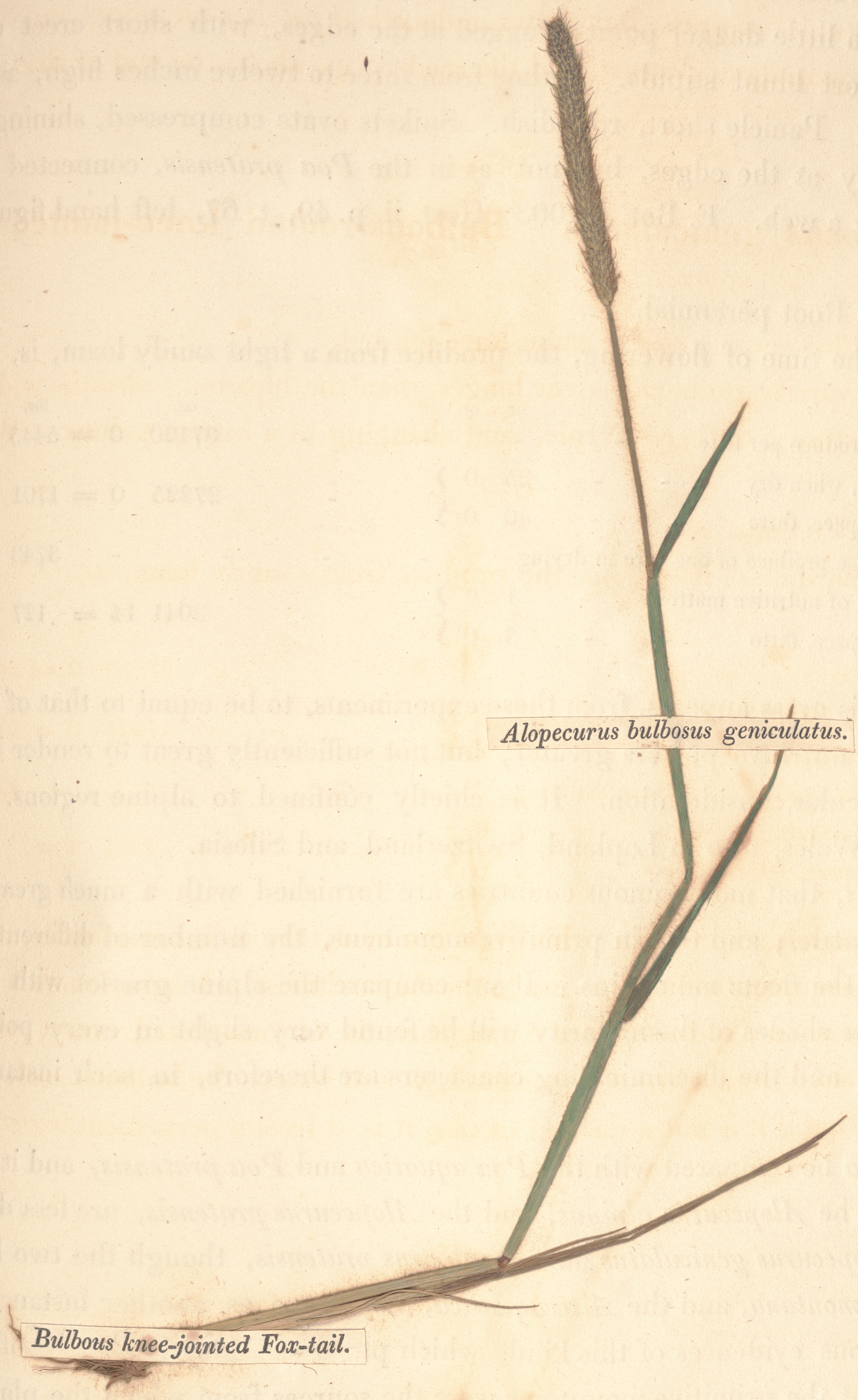
Obs.—Root of this variety bulbous; awns longer than the blossom; sheaths wider than the thickness of the straw; anthers purple, and changing to a brown yellow. Wither. Arr. ii. p. 120.

Native of Britain. Perennial.

Experiments.—At the time of flowering, the produce from a sandy loam, is,

	dr.	qr.	oz.		lbs.	
Grass, 8 oz. The produce per acre - - - - - -			87120	0 =	5445	5
80 dr. of grass weigh, when dry - -	16	0	- - - 17424	0 =	1089	0
The produce of the space, ditto - -	25	$2\frac{2}{5}$				
The weight lost by the produce of one acre in drying - - - - -					4356	0
64 dr. of grass afford of nutritive matter -	1	0	- - - 1361	4 =	85	1
The produce of the space, ditto - -	2	0				

The produce and nutritive powers of this grass are evidently so inconsiderable, as to justify a conclusion that it is comparatively of no use to the Agriculturist. I have found it but seldom in a wild state. It grows on a soil of a drier nature than the fibrous-rooted variety, to be spoken of hereafter. When raised from seed on a moist soil, it still retains the bulbous root, which goes the length to prove, that if it is not a distinct *species,* it is at least a permanent *variety.*



Alopecurus bulbosus geniculatus.

Bulbous knee-jointed Fox-tail.

Poa alpina. Alpine Meadow-grass.

Specific character: Panicle diffused, 4-11 flowered, cordate; florets, acute, free; sheath-scale oblong, acute; leaves short, obtuse, pointed; root fibrous.

Obs.—Root-leaves numerous, flat, widish, nerved, smooth, especially underneath, bluntish at the end, with a little dagger point; rugged at the edges, with short erect compressed sheaths, and a short blunt stipula. Culms from three to twelve inches high, ascending, a little compressed. Panicle short, roundish. Spikets ovate compressed, shining with purple. Florets silky at the edges, but not, as in the *Poa pratensis*, connected by complicated hairs, or by a web. E. Bot. t. 1003; Host. ii. p. 49, t. 67, left hand figure; Curtis; Flo. Dan. t. 807.

Native of Britain. Root perennial.

Experiments.— At the time of flowering, the produce from a light sandy loam, is,

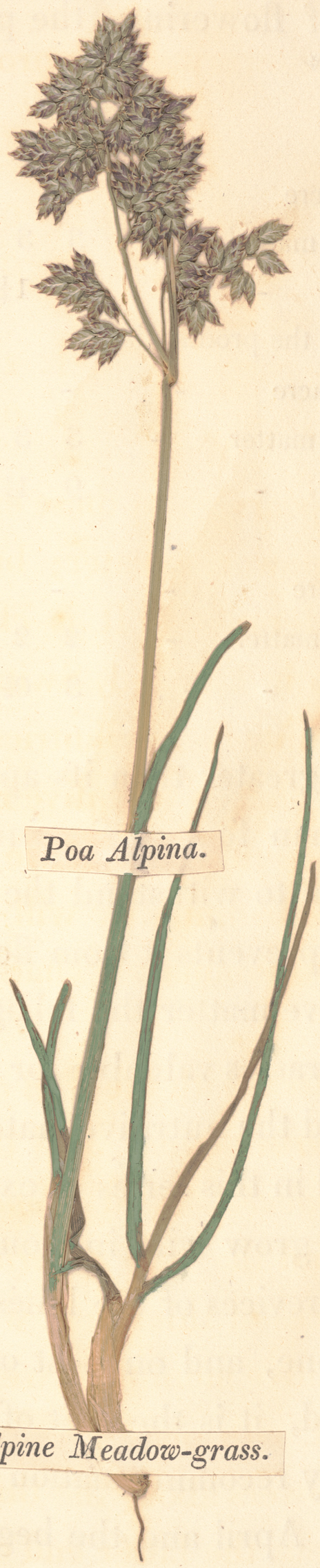
	dr.	qr.		oz.		lbs.		
Grass, 8 oz. The produce per acre - - - -				87120	0 =	5445	0	0
80 dr. of grass weigh, when dry - -	25	0	-	27225	0 =	1701	9	0
The produce of the space, ditto - -	40	0						
The weight lost by the produce of one acre in drying - - - -				3743	7	0		
64 dr. of grass afford of nutritive matter -	1	2	-	2041	14 =	127	9	14
The produce of the space, ditto - -	3	0						

The produce of this grass appears, from these experiments, to be equal to that of the *Alopecurus alpinus,* and its nutritive powers greater; but not sufficiently great to render it an object for the Farmer's particular consideration. It is chiefly confined to alpine regions. It grows wild in Scotland and Wales, also in Lapland, Switzerland, and Silesia.

Botanists inform us, that mountainous countries are furnished with a much greater variety of plants than flat countries; and that in primitive mountains, the number of different species of plants exceeds that of the floetz mountains. If we compare the alpine grasses with those that inhabit the valleys, the shades of dissimilarity will be found very slight in every point, except what arises from size; and the discriminating characters are therefore, in such instances, often minute.

Let the *Poa alpina* be compared with the *Poa aquatica* and *Poa pratensis,* and it will afford an example of this. The *Alopecurus alpinus,* and the *Alopecurus pratensis,* are less dissimilar in structure than the *Alopecurus geniculatus* and *Alopecurus pratensis,* though the two last inhabit the plain. The *Aira montana,* and the *Aira aquatica,* may serve as another instance for comparison. The numerous evidences of this kind, which plants of every class have offered, have led to the opinion, that the primitive mountains were the sources from which the plains, formed at a later period, were furnished with plants.

The Alpine Meadow-grass flowers about the third week of May, and during the rest of the summer, and the seed ripens about the latter end of June, and successively, according as the grass produces flowers. Hares and rabbits are remarkably fond of this grass, and snails devour the flowering spikets of the panicle; it requires therefore much care and attention to obtain either seed or perfect specimens of the flowers.


Poa Alpina.
Alpine Meadow-grass.

Sesleria cærulea. Blue Moor-grass.

Cynosurus cæruleus. Linn.; Mart. Flo. Rust. t. 20; Jacq. i. t. 21.

Specific character: Spike egg-oblong, leafy; spikets 2-3 flowered; outer husk of the corolla with 3, seldom 5 awns; awns shorter than the husk. E. Bot. 1613.

Obs.—The roots take a slanting direction in the earth; the leaves grow in dense tufts. Culms from four to twelve inches high, roundish, or compressed, striated, smooth. Leaves linear, somewhat obtuse, keeled, rough on the edges and upper part of the keel, between sea-green and bluish. Spike of a lead colour, or sometimes inclining to a purple. Spikets short, pedicelled, mostly in pairs, oblong oval, compressed, 2-3 flowered, shining.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a light sandy soil incumbent on clay, is,

	dr.	qr.	oz.		lbs.		
Grass, 11 oz. The produce per acre - - - -			119790	0 =	7486	14	0
64 dr. of grass afford of nutritive matter -	3	3	- -	7018 13 =	438	10	13
The produce of the space, ditto - -	10	1¼					
At the time the seed is ripe, the produce is,							
Grass, 10 oz. The produce per acre - - - -			108900	0 =	6806	4	0
64 dr. of grass afford of nutritive matter -	3	3	- -	5130 13 =	320	10	13
The produce of the space, ditto - -	9	1½					
The produce of latter-math is,							
Grass, 5 oz. The produce per acre - - - -			54450	0 =	3403	2	0
64 dr. of grass afford of nutritive matter -	2	2	- -	2126 15 =	132	14	15
The produce of the space, ditto - -	3	0¾					

The produce of this grass is greater than its appearance when growing would indicate; the leaves seldom attain to more than four or five inches in length. Its growth is not rapid after being cropped, nor does it seem to withstand the effects of frost, which, if it happen to come severe, or early in the spring, prevents it from flowering in that season; otherwise the comparatively great quantity of nutritive matter the foliage affords, (for the culms are very inconsiderable), might rank it with the grasses valuable for permanent pasture.

If the weight of produce, and the nutritive matter it contains, be compared with those of the Alpine grasses that are included in this series of experiments, the Blue Moor-grass will be found greatly superior. It is said to grow wild in mountainous pastures in the North of England, and sometimes in marshes, in crevices of the limestone rocks at the foot of Ingleborough, lime rocks near Kendal, Malham Cone, and on most of the lime rocks in Craven, Yorkshire*.

Though, as already observed, it is the best of the Alpine grasses, yet the above details of its properties do not warrant any recommendation of its cultivation to the Farmer.

It flowers about the end of April and the beginning of May, and the seed is ripe in the first and second weeks of June.

* Withering's Arrangements, ii. p. 140.

Sesleria cærulea.

Blue Moor-grass.

Aira cristata. Crested Hair-grass.

Poa cristata. Crested Meadow-grass. Host. ii. p. 54, t. 75.

Specific character: Panicle, spike-like; husks acuminate; flowers longer than the calyx; leaves ciliated.

Obs.—This grass was formerly ranked by Botanists under the genus *Poa*, but has since been referred to that of *Aira*, to which it is more closely allied by its two-flowered calyx and acuminate glumes; culms from a foot to a foot and a half high, round, striated, a little pubescent towards the top, erect from the lower joint upwards, under that decumbent; leaves linear, acute, flat, roughish at the margin, and ciliated; sheath-scale very short, more or less ciliate; panicle erect, cylindrical, but tapering on each side; spike-stalk pubescent, smooth towards the top, and furnished with a few hairs; calyx acuminated, compressed, keeled, terminated by an awn-like point.

Native of Britain. Root perennial. E. Bot. t. 648.

Experiments.—At the time of flowering, the produce from a sandy loam, is,

	dr.	qr.	oz.		lbs.	
Grass, 16 oz. The produce per acre - - - -			174240	0 =	10890	0
80 dr. of grass weigh, when dry - -	36	0	- - 78408	0 =	4900	8
The produce of the space, ditto - -	115	$0\frac{3}{16}$				
The weight lost by the produce of one acre in drying - - - - - -					5989	8
64 dr. of grass afford of nutritive matter -	2	0	- - 5445	0 =	340	5
The produce of the space, ditto - -	8	0				
At the time the seed is ripe, the produce is,						
Grass, 10 oz. The produce per acre - - - - -			108900	0 =	6806	4
80 dr. of grass weigh, when dry - -	40	0	- - 54450	0 =	3403	2
The produce of the space, ditto - -	80	0				
The weight lost by the produce of one acre in drying - - - - - -					3403	2
The weight of nutritive matter which is lost by leaving the crop till the seed be ripe, is -					127	10

The produce of this species, and the nutritive matter it affords, are equal to those of the *Festuca ovina* at the time the seed is ripe; they equally delight in dry soils, though the *Aira cristata* will thrive well, and remain permanent in soils of a moist and clayey nature, which is different with the *Festuca ovina.* The greater bulk of the produce of the *Aira cristata*, in proportion to its weight, makes it of inferior value to the *Festuca ovina.* In some parts of the country it grows on dry pastures plentifully, where it appears to be but sparingly eaten by cattle, particularly if the pasture be not over-stocked. Rye-grass, *(Lolium perenne);* sheep's fescue, *(Festuca ovina);* yellow oat-grass, *(Avena flavescens);* crested dog's-tail, *(Cynosurus cristatus);* meadow barley, *(Hordeum pratense);* flexuose hair-grass, *(Aira flexuosa),* are all preferred by cattle to the Crested Hair-grass. The nutritive matter of this grass differs but little in its composition from those of the above; it approaches nearest to that of the *Aira flexuosa,* differing only in having less bitter extractive matter and more tasteless mucilage; but the soft hairy foliage of the grass appears at once the cause of this dislike in cattle to eat it.

It flowers about the first week in July, and the seed is ripe about the beginning of August.

Aira cristata.

Crested Hair-grass.

Poa compressa. Flat-stalked Meadow-grass.

Specific character: Panicle flowering on one side, diffuse; spikets oval-oblong, 5-7 flowered; flowers connected at the base by a complicated web of hairs; culm compressed; root creeping.

Obs.—Culms from a foot to a foot and a half high, compressed, decumbent at the base, oblique afterwards, and erect towards the top; striated, smooth, sometimes sending forth culms at the joints; leaves short, linear, acute, flat, somewhat glaucous; panicle erect, short, directed one way, glaucous, bluntish, condensed; florets from three to nine, according to the age and strength of the plant, closely imbricated, oval, angular, three-nerved, purple below the tip, which is silvery and scariose at the base, connected by very fine complicated short villous hairs. Dr. Withering says that they are rarely woolly at the base. E. Bot. t. 365; Host. ii. p. 51, t. 70; Flo. Dan. t. 742; Flo. Ger. 303; Wither. Arr.

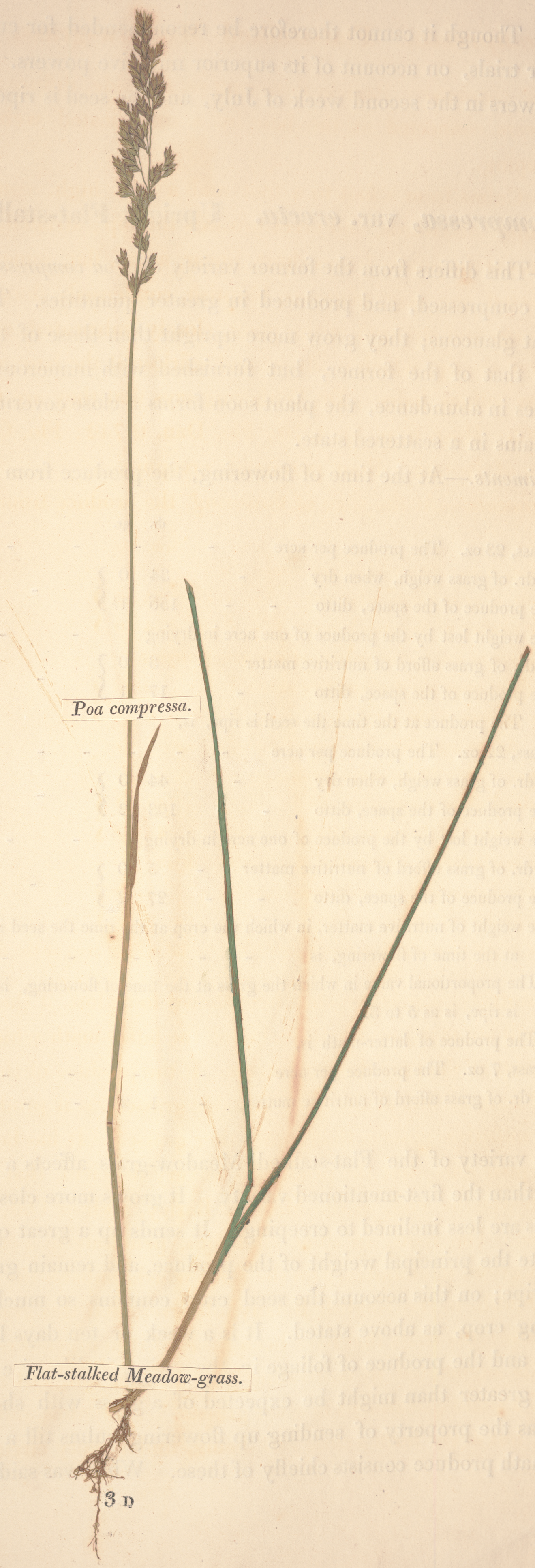
Native of Britain. Root perennial, creeping.

Experiments.—At the time of flowering, the produce from a gravelly soil with manure, is,

	dr.	qr.		oz.		lbs.		
Grass, 5 oz. The produce per acre - - - - - -				54450	0 =	3403	2	0
80 dr. of grass weigh, when dry - -	34	0	- -	23141	4 =	1446	5	4
The produce of the space, ditto - -	34	0						
The weight lost by the produce of one acre in drying - - - -				1956	12	12		
64 dr. of grass afford of nutritive matter -	5	0	- -	4253	14 =	265	13	14
The produce of the space, ditto - -	6	1						
At the time the seed is ripe, the produce is,								
Grass, 6 oz. The produce per acre - - - - -				65340	0 =	4083	12	0
80 dr. of grass weigh, when dry - -	40	0	- -	32670	0 =	2041	14	0
The produce of the space, ditto - -	48	0						
The weight lost by the produce of one acre in drying - - - - - -				2041	14	0		
64 dr. of grass afford of nutritive matter -	5	0	- -	5104	11 =	319	0	11
The produce of the space, ditto - - -	7	2						
The weight of nutritive matter which is lost by taking the crop at the time of flowering, is						53	2	13

The nutritive matter which is here shewn to be lost, if the crop is taken when the grass is in flower, will not make up for the value of the latter-math which would otherwise be lost by taking the crop at the time the seed is ripe. If the produce of this grass was of greater magnitude, it would rank as one of the most valuable grasses, as it produces foliage early in the spring, of stronger nutritive powers than most other grasses. It has been recommended as a grass to cultivate on poor soils; but the produce is so very deficient, that there are other grasses that might better answer the end, as the Meadow Barley, Yellow Oat, Hard Fescue, and Crested Dog's-tail Grass. The roots, in some situations, penetrate to a considerable depth, as in stony dry soils. It grows in abundance on the walls which embank the ponds in Woburn-park.

Dr. Smith, in the English Botany, observes, that this grass can scarcely be put to any agricultural use: the trials that have been made of it here, confirm that opinion. It is true, that the produce is augmented by cultivating it on a richer soil, but not in that proportion which is the result of a similar treatment in other grasses. The culms and leaves attain a greater length on a rich soil, but never form a close turf, being, under every circumstance, thinly scattered over the


Poa compressa.
Flat-stalked Meadow-grass.
3 D

surface. Though it cannot therefore be recommended for cultivation, nevertheless it is worthy of further trials, on account of its superior nutritive powers.

It flowers in the second week of July, and the seed is ripe about the middle of August.

Poa compressa, var. *erecta*. Upright Flat-stalked Meadow-grass.

Obs.—This differs from the former variety of *Poa compressa*, in having culms more upright, less compressed, and produced in greater quantities. The colour of the leaves is somewhat glaucous; they grow more upright than those of the other variety. Root creeping like that of the former, but furnished with numerous fibres, which supply culms and leaves in abundance, the plant soon forms a close covering to the ground, while the other remains in a scattered state.

Experiments.—At the time of flowering, the produce from a light sandy loam, is,

	dr.	qr.		oz.		lbs.		
Grass, 23 oz. The produce per acre - - - -				250470	0 =	15654	6	0
80 dr. of grass weigh, when dry -	34	0	- -	106449	12 =	6653	1	12
The produce of the space, ditto - -	156	$1\frac{3}{5}$						
The weight lost by the produce of one acre in drying - - - -				9001	4	4		
64 dr. of grass afford of nutritive matter -	3	0	- -	11740	12 =	743	12	12
The produce of the space, ditto -	17	1						
The produce at the time the seed is ripe, is,								
Grass, 22 oz. The produce per acre - - - - - -				239580	0 =	14973	12	0
80 dr. of grass weigh, when dry -	44	0	- -	131769	0 =	8235	9	0
The produce of the space, ditto - -	193	2						
The weight lost by the produce of one acre in drying - - - -				6738	3	0		
64 dr. of grass afford of nutritive matter -	5	0	- -	18717	3 =	1169	13	3
The produce of the space, ditto - -	27	2						
The weight of nutritive matter, in which the crop at the time the seed is ripe, exceeds that at the time of flowering, is - - - - - - -				426	0	7		
The proportional value in which the grass at the time of flowering, is inferior to that at the time the seed is ripe, is as 5 to 3.								
The produce of latter-math is,								
Grass, 7 oz. The produce per acre - - - -				76230	0 =	4764	6	0
64 dr. of grass afford of nutritive matter -	1	2	- - -	1786	10 =	111	10	10

This variety of the Flat-stalked Meadow-grass affects a soil of a moister, and more rich nature, than the first-mentioned variety. It grows more close, forming a pretty good sward; the roots are less inclined to creeping. It sends up a great quantity of flowering culms, which constitute the principal weight of the produce, and remain green and succulent long after the seed is ripe; on this account the seed crop contains so much more nutritive matter than the flowering crop, as above stated. It is a week or ten days later in flowering, than the former variety, and the produce of foliage in the spring is likewise inferior. The produce of latter-math is greater than might be expected of a grass with short slow-growing foliage, but the plant has the property of sending up flowering culms till a late period of the season, and the latter-math produce consists chiefly of these. What was said respecting the merits of the first

Poa compressa erecta.

Upright flat-stalked Meadow-grass.

variety, may also be said of this one; for though its produce be greater, and form a better turf, yet it is inferior in early growth, and in the produce of foliage.

It flowers in the end of July, and the seed is ripe about the beginning of September.

Lotus corniculatus. Bird's-foot Trefoil, Bird's-foot Clover.

Generic character: Legume cylindrical, straight; wings of the corolla cohering by their upper edge; calyx tubular; filaments dilated upwards.

Specific character: Heads depressed, of few flowers; stems decumbent, solid; legumes spreading, nearly cylindrical; claw of the keel obovate; filaments all dilated. E. Bot. 2090.

Obs.—Some Botanists have considered the next following plant *(Lotus major)* a variety of this "var. larger, stem more upright." Linn. and Withering. But the difference between them is obvious at the first sight; and this difference remains permanent, when the plant is raised from seed and cultivated on different soils. What renders a specific distinction here of most importance to the Farmer, is the difference which exists between them in an agricultural point of view. The stems are prostrate, smooth, apparently free from hairs; leaves slightly veined underneath, smooth. Curtis, 107; Flo. Dan. 991; Wither. Arr.

Native of Britain, and all parts of Enrope; also of Japan. Root perennial.

Experiments.—At the time of flowering, the produce from a clayey loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 15 oz. The produce per acre - - - - - -			163350	0 =	10209	6	0
80 dr. of grass weigh, when dry - -	25	0	- -	51046	0 =	3190	6	0
The produce of the space, ditto - -	75	0					
The weight lost by the produce of one acre in drying - - - - - - -				7019	0	0	
64 dr. of grass afford of nutritive matter -	2	1	- - -	5742	9 =	358	14	9
The produce of the space, ditto - - -	8	1¾					

This plant has been recommended for cultivation by Dr. Anderson, Mr. Curtis, and Mr. Woodward. Linnæus says that cows, goats, and horses eat it; and that sheep and swine are not fond of it. With regard to sheep, as far as my observations have extended, they eat it in common with the herbage with which it is usually combined; the flowers, it is true, appeared always untouched, and, in dry pastures, little of the plant is seen or presented to cattle, except the flowers, on account of its diminutive growth in such situations. This, however, is nearly the case with White or Dutch Clover; sheep seldom touch the flowers while any foliage is to be found.

Mr. Woodward informs us, that it makes extremely good hay in moist meadows, where it grows to a greater height than the Trefoils, and seems to be of a quality equal, if not superior to most of them. Professor Martyn observes, that in common with several other leguminous plants, it gives a substance to hay, and perhaps renders it more palatable and wholesome to cattle. It has been already observed, that the Clovers contain more bitter extractive and saline matters than the proper natural grasses, and the Bird's-foot Trefoils contain more of these vegetable principles than the Clovers; in pastures and meadows, therefore, where the Clovers happen to be in small quantities, a portion of the Trefoil, *(Lotus corniculatus)*, would doubtless be of advantage; but it appears to contain too much of the bitter extractive and saline matters to be cultivated by itself, or without a large intermixture of other plants.

Lotus corniculatus.

Bird's-foot Trefoil.

It does not spring early in the season, but continues to vegetate late in the autumn. In irrigated meadows, where the produce is generally more succulent than in dry pastures, this plant cannot with safety be recommended, at least in any considerable quantity. It is more partial to dry soils than the next species, *Lotus major;* it attains to a considerable height when growing among shrubs, and seems to lose its prostrate or trailing habit of growth entirely, when in such situations.

It comes into flower about the second week of June, and the seed is ripe about the end of July, and successively till the end of autumn.

Lotus major. Greater Bird's-foot Trefoil.

Specific character: Heads depressed, many-flowered; stems erect, hollow; legumes spreading, cylindrical; claw of the keel linear, shorter, filaments not dilated.

Dr. Smith, in E. Bot.

Obs.—Stems from one to two and a half feet high, according as it is more or less drawn up by bushes, or exposed without shade, more or less fringed with long loosely-spreading hairs; leaves also more or less fringed with similar hairs; flower-heads when young very hairy, flowers from 6 to 12 in each head, of a duller orange than the preceding species; pod slender, and exactly cylindrical. E. Bot. 2091.—I have raised this plant from seed on two different soils, a siliceous sandy soil and a clayey loam, and the above characters remain permanent in both instances: it is surprising that two plants so distinct in habits, should have so long been considered varieties only.

Native of Britain. Root perennial, creeping.

Experiments.—At the time of flowering, the produce from a clayey loam, is,

	dr.	qr.		oz.		lbs.	
Herbage, 32 oz. The produce per acre - - - -				348480	0 =	21780	0
80 dr. of herbage weigh, when dry - -	30	0	- -	13068	0 =	8142	8
The produce of the space, ditto - -	192	0					
The weight lost by the produce of one acre in drying - - - - -						13637	8
64 dr. of grass afford of nutritive matter -	2	0	- -	10890	0 =	680	10
The produce of the space, ditto - -	16	0					

The weight of green food, or hay, is triple that of the foregoing species, and its nutritive powers are very little inferior, being only as 9 to 8. These two species of Bird's-foot Trefoil may be compared to each other with respect to habits, in the same manner as the White Clover and Perennial Red Clover; and were the latter unknown, there appear to be no plants of the leguminous order, that, in point of habits, would so well supply their place as the Common and Greater Bird's-foot Trefoil. They are, however, greatly inferior to the Clovers. The White Clover is superior to the Common Bird's-foot Trefoil in the quantity of nutritive matter it affords, in the proportion of 5 to 4. It is much less productive of herbage, and is much more difficult of cultivation, the seed being afforded in much smaller quantities. The produce of the Greater Bird's-foot Trefoil is superior to that of the Perennial Red Clover, on tenacious or moist soils, and on drier, and on richer soils of the first quality; but the produce is inferior, in the

Lotus major.
Greater Bird's-foot Trefoil.

proportion of nutritive matter it contains, as 5 to 4. The nutritive matter of this species contains more bitter extractive and saline matters than that of the former, which was before shewn to be in excess when compared to the Clovers, and these to the proper natural grasses. The nutritive matter is extremely bitter to the taste. It does not appear to be eaten by any cattle when in a green state, but when made into hay with the common grasses, I have offered it to sheep, oxen, deer, and the Llama, or South American sheep; and they all ate it without reluctance, and rather with desire.

It does not seem to perfect so much seed as the former species; but this is abundantly remedied in its propagation by the creeping or stoloniferous roots, which it spreads out in all directions, and thus it soon covers a large space of ground. But the culms rise not in considerable number; they are thinly scattered over the surface. In moist clayey soils it would doubtless be a most profitable substitute for Red Clover; but the excess of bitter extractive and saline matters it contains, seems to forbid its adoption without a considerable admixture of other plants.

It flowers about the third week of June, and the seed is ripe about the end of the following month.

Avena pratensis. Meadow Oat-grass.

Specific character: Panicle spike-like; spike generally 5-flowered; flowers longer than the calyx; leaves roughish, narrow, doubled together.

Obs.—Culms perfectly smooth, erect, straight, round, upper half naked, and scored. Panicle equal, erect. Florets 4-5, somewhat compressed, terminating one imperfect. Husks of the calyx acuminate, compressed, rough on the keel, three-nerved, inner husk the smallest. Outer husk of the corolla acuminate, five-nerved, with an awn from below the middle longer than the husk, knee-bent, inner valve smaller. E. Bot. 1204; Host. t. 51; Flo. Ger. 385; Wither. Arr.

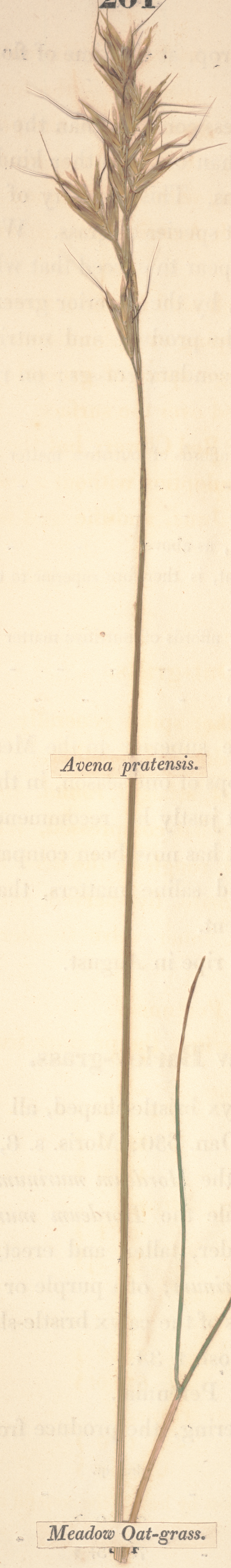
Native of Britain. Root fibrous. Perennial.

Experiments.—At the time of flowering, the produce from a sandy loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 10 oz. The produce per acre - - - - - -			108900	0 =	6806	4	0
80 dr. of grass weigh when dry - -	22	0	- - 29947	8 =	1871	11	8
The produce of the space, ditto - -	44	0					
The weight lost by the produce of one acre in drying - - - -					4934	8	8
64 dr. of grass afford of nutritive matter -	2	1	- - 3828	8 =	239	4	8
The produce of the space, ditto - -	5	$2\frac{1}{2}$					

At the time the seed is ripe, the produce is,

	dr.	qr.	oz.		lbs.		
Grass, 14 oz. The produce per acre - - - -			152460	0 =	9528	12	0
80 dr. of grass weigh when dry - -	24	0	- - 45738	0 =	2858	10	0
The produce of the space, ditto - -	67	$0\frac{4}{5}$					
The weight lost by the produce of one acre in drying - - - -					6670	2	0
64 dr. of grass afford of nutritive matter -	1	0	- - - 2382	3 =	148	14	3
The produce of the space, ditto - - -	3	2					
The weight of nutritive matter which is lost by leaving the crop till the seed be ripe, exceeds one-third part of its value - - - - - - - - - - - -					90	6	5



Avena pratensis.

Meadow Oat-grass.

The proportional value which the crop, at the time of flowering, bears to that at the time the seed is ripe, is as 9 to 4.

This species of Oat-grass is much less common than the *Avena pubescens* or *Avena flavescens*. It is found more frequent on chalky, than on any other kind of soils: I have also found it in moist meadows as well as on dry heaths. This property of thriving on soils of such opposite natures, is not common to the different species of grass. When this grass was planted in an irrigated meadow, the produce did not appear to exceed that which it afforded on a dry elevated soil, though it appeared more healthy, by the superior green colour of the foliage; and it thus appears to thrive under irrigation. The produce and nutritive powers, however, seem to be inferior to many other species of the secondary grasses: on referring to former details, we find that

				lbs.
The yellow oat-grass (*Avena flavescens*), affords of nutritive matter from the crop at the time of flowering - - - - - -	478	9	0	909
From the crop at the time the seed is ripe - - - - - - - -	430	11	5	
The meadow oat-grass (*Avena pratensis*), as above - - - - - -				388

The produce, or value of the Yellow Oat, is therefore superior to that of the Meadow Oat, in the proportion nearly of 7 to 3.

The downy oat-grass (*Avena pubescens*), affords of nutritive matter from the grass at the time of flowering - - - - - - - - - - -	366	578
From the crop at the time the seed is ripe - - - - - - - - -	212	

The Downy Oat-grass is therefore superior to the Meadow Oat-grass in the quantity of nutritive matter it affords from the crops of one season, in the proportion nearly of 3 to 2. From these facts and observations, it cannot justly be recommended for cultivation in preference to either of the two species with which it has now been compared. Its nutritive matter contains a less proportion of bitter extractive and saline matters, than any other of the Oat grasses that have here been submitted to experiment.

It flowers in July, and the seed is ripe in August.

Hordeum pratense. Meadow Barley-grass.

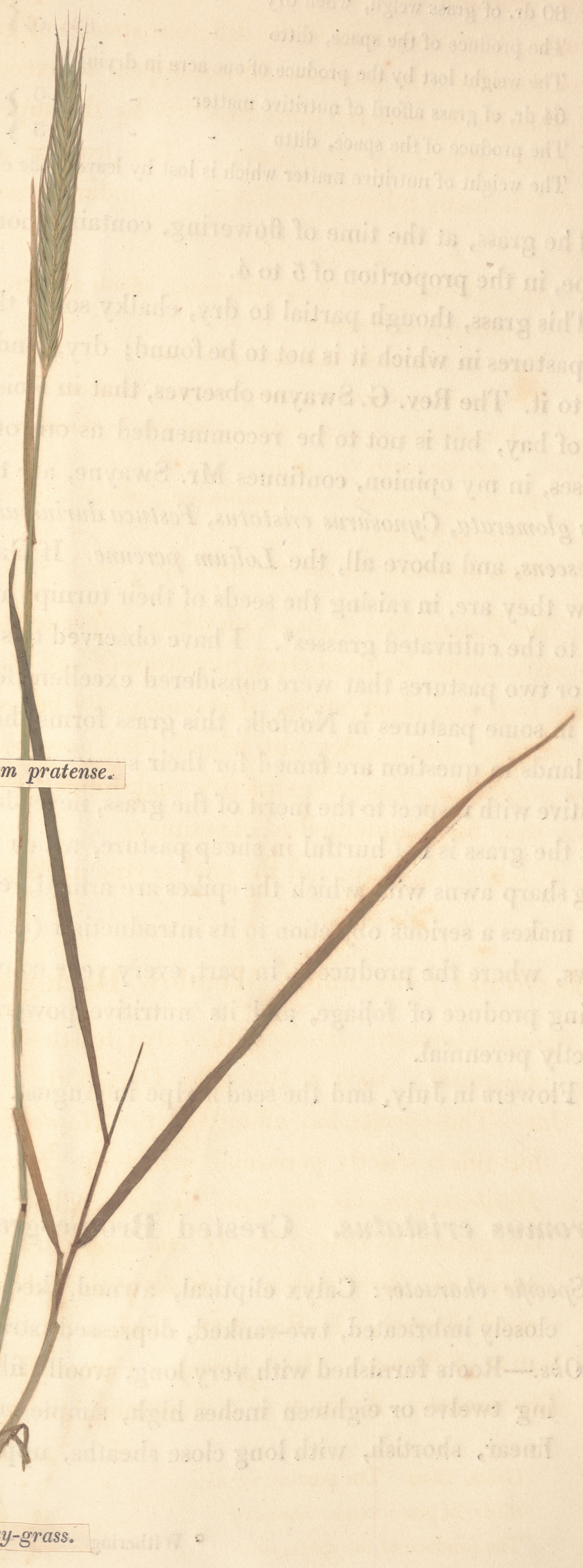
Specific character: Husks of the calyx bristle-shaped, all the florets awned, the lateral ones unisexual. Mart. t. 108; Flo. Dan. 630; Moris. s. 8, t. 2, f. 6.

Obs.—This species has affinity to the *Hordeum murinum*, wall barley-grass, in appearance; but this is strictly perennial, while the *Hordeum murinum* is annual. The culms of the *Hordeum pratense* are more slender, taller, and erect, sheaths roundish, spike slender in comparison to that of the *H. murinum;* of a purple or greenish hue; that of the *H. murinum* is of a dirty yellow. Husks of the calyx bristle-shaped, rough, but not ciliate. Awns much shorter. E. Bot. 409; Host. t. 33.

Native of Britain. Root fibrous. Perennial.

Experiments.—At the time of flowering, the produce from a sandy loam with manure, is,

	dr.	qr.	oz.		lbs.		
Grass, 12 oz. The produce per acre - - - -			130680	0 =	8167	8	0
80 dr. of grass weigh, when dry - - -	32	0					
The produce of the space, ditto - -	76	$3\frac{1}{5}$	52272	0 =	3267	0	0
The weight lost by the produce of one acre in drying - - - -					4900	8	0



Hordeum pratense.

Meadow Barley-grass.

	dr.	qr.	oz.		lbs.		
64 dr. of grass afford of nutritive matter -	3	3	7657	0 =	478	9	0
The produce of the space, ditto - - -	11	1					
At the time the seed is ripe, the produce is,							
Grass, 13 oz. The produce per acre - - - - -			141570	0 =	8848	2	0
80 dr. of grass weigh, when dry - -	32	0	56628	0 =	3539	4	0
The produce of the space, ditto - -	83	0½					
The weight lost by the produce of one acre in drying - - - -					5308	14	0
64 dr. of grass afford of nutritive matter -	3	0	6636	1 =	414	12	1
The produce of the space, ditto - -	9	3					
The weight of nutritive matter which is lost by leaving the crop till the seed be ripe, is -					63	14	0

The grass, at the time of flowering, contains more nutritive matter than at the time the seed is ripe, in the proportion of 5 to 4.

This grass, though partial to dry, chalky soils, thrives under irrigation; and there are but few pastures in which it is not to be found; dry, sandy heaths, and moist sour soils, are uncongenial to it. The Rev. G. Swayne observes, that in moist meadows, it produces a considerable quantity of hay, but is not to be recommended as one of the best grasses for the Farmer. The best grasses, in my opinion, continues Mr. Swayne, are the *Alopecurus pratensis, Poa trivialis, Dactylis glomerata, Cynosurus cristatus, Festuca duriuscula, Festuca pratensis, Festuca hybrida, Avena flavescens*, and above all, the *Lolium perenne*. If Gardeners and Farmers are so careful, as we know they are, in raising the seeds of their turnips and cabbages, surely some of their care is due to the cultivated grasses*. I have observed this grass to constitute the principal herbage of one or two pastures that were considered excellent for sheep. I have been informed, likewise, that in some pastures in Norfolk, this grass forms the principal herbage; and the proprietors of the lands in question are famed for their superior breed of sheep. Though this proves nothing positive with respect to the merit of the grass, nevertheless, it offers satisfactory reasons to conclude that the grass is not hurtful in sheep pasture, which is not the case when it is made into hay, the long sharp awns with which the spikes are armed, rendering it dangerous to the mouths of cattle, and makes a serious objection to its introduction (at least in large quantities) into irrigated meadows, where the produce is, in part, every year converted into hay. It is tolerably early in the spring produce of foliage, and its nutritive powers are considerable. It is very hardy, and strictly perennial.

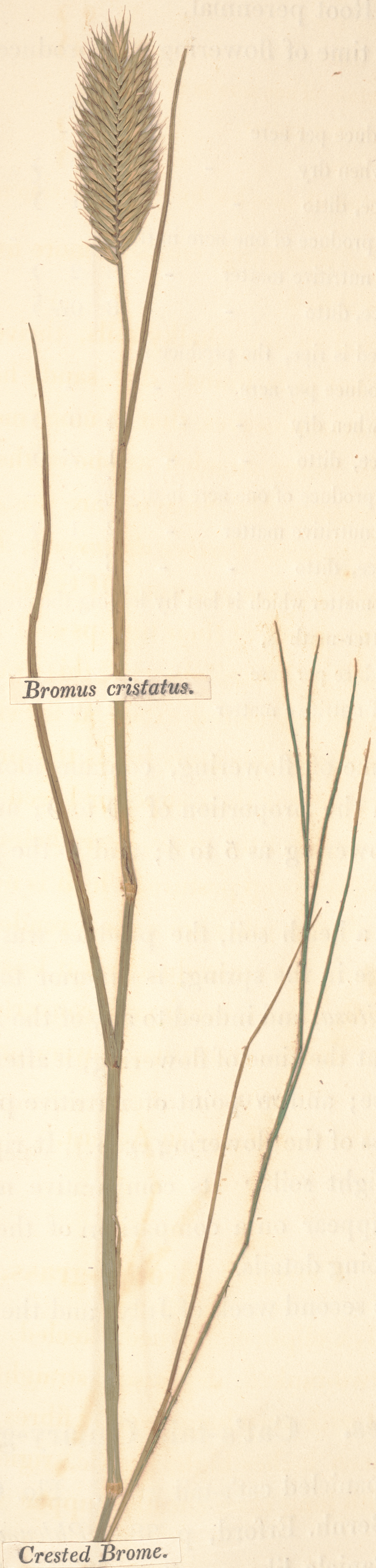
Flowers in July, and the seed is ripe in August.

Bromus cristatus. Crested Brome-grass.

Specific character: Calyx eliptical, awned, keeled, obtusely ribbed; florets awned; spikets closely imbricated, two-ranked, depressed, straight; stem simple. E. Bot.

Obs.—Roots furnished with very long, woolly fibres, adapted to grow in sands; culms ascending twelve or eighteen inches high, simple, rigid, slender, leafy, hairy at the top; leaves linear, shortish, with long close sheaths, upper surface in one specimen hairy; but Gme-

* Withering's Arr. ii. p. 172, Ed. 4.



Bromus cristatus.

Crested Brome.

lin says the character is variable. The *Secale prostratum* is a-kin to this, but has an annual root and a branched stem. E. Bot.—The *Triticum cristatum* of Host agrees with the above, and the upper surface of the leaves are hairy. Host. ii. t. 24, *Triticum cristatum—Secale prostratum?* Jacquin.

Native of Scotland. Root perennial.

Experiments.—At the time of flowering, the produce from a clayey loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 13 oz. The produce per acre - - - -			141570	0 =	8848	0	0
80 dr. of grass weigh, when dry -	32	0					
The produce of the space, ditto - -	83	1	- -	56628	0 =	3539	4 0
The weight lost by the produce of one acre in drying - - - -					5308	14	0
64 dr. of grass afford of nutritive matter -	2	2					
The produce of the space, ditto - -	8	$0\frac{2}{10}$	- -	5530	1 =	345	10 1

At the time the seed is ripe, the produce is,

Grass, 12 oz. The produce per acre - - - -			130680	0 =	8167	8	0
80 dr. of grass weigh, when dry - -	34	0					
The produce of the space, ditto - -	81	$2\frac{2}{5}$	- -	55539	0 =	3458	11 0
The weight lost by the produce of one acre in drying - - - - -					4708	13	0
64 dr. of grass afford of nutritive matter -	2	1					
The produce of the space, ditto - -	6	3	- -	4594	3 =	255	11 3
The weight of nutritive matter which is lost by leaving the crop till the seed be ripe, is -					89	14	14

The produce of latter-math is,

Grass, 4 oz. The produce per acre - - - - -			43560	0 =	2722	8	0
64 dr. of grass afford of nutritive matter	2	0	- - -	1361	4 =	85	1 4

The grass, at the time of flowering, contains more nutritive matter than the grass at the time the seed is ripe, in the proportion of 10 to 9; and the grass of the latter-math is superior to that at the time of flowering as 5 to 4; and to the grass, at the time the seed is ripe, in the proportion of 9 to 8.

When cultivated on a heath soil, the produce was very nearly the same as the above. The produce of early herbage in the spring, is superior to the *Avena flavescens, Festuca duriuscula, Festuca ovina, Aira cæspitosa,* and indeed to any of the Alpine grasses, or those which affect sandy dry soils. When mown at the time of flowering, it afterwards sends up culms, and the latter-math consists chiefly of these; and in point of nutritive powers, the latter-math is in consequence nearly equal to the grass of the flowering crop. It ripens a sufficiency of seed, which vegetates freely when sown on light soils. Its comparative merits, as a grass for heath soils, are very considerable, as will appear on a comparison of their habits, produce, and nutritive qualities, mentioned in the foregoing details.

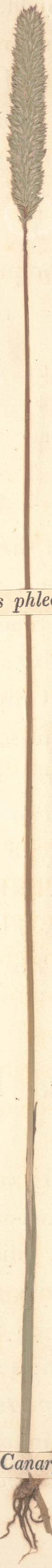
It flowers about the second week of July, and the seed is ripe about the end of August.

Phalaris phleoides. Cat's-tail Canary-grass.

Phleum Boehmeri, panicled cat's-tail grass. Flo. Ger.

Phleum glabrum. Bernh. Erford, p. 38.—*Phleum phalaroides.* Koel. Gram. p. 52.

Specific character: Panicle like a spike, cylindrical; husks of the calyx spear-shaped, obtuse, rather mucronate, roughish.



Phalaris phleoides.

Cat's-tail Canary-grass.

Obs.—Culms numerous, with a bulbous joint at the base, often of a purplish colour; leaves linear, acute, flat, on the back and towards the point roughish, of a light green or glaucous colour; panicle attenuated, of a green, or varying from a green to a purple colour; calyx twice the size of the corolla, valves more or less rough, with hairs on the keel towards the top; corolla, outer valve oval, spear-shaped, obtuse, five-nerved, naked, or with very short hairs distinguishable by the microscope; interior valve a little smaller, narrower, acute. Host. ii. p. 26, t. 34; Flo. Dan. t. 531.—I have not in this instance been able to refer to the description in the English Botany. I have, however, followed that authority in calling this grass a *Phalaris*, otherwise I am ready to believe it is more closely allied to the *Phleum Alpinum* than to any other grass.

Native of Britain. Root fibrous, perennial.

Experiments.—At the time of flowering, the produce from a siliceous sandy soil, is,

	dr.	qr.	oz.		lbs.		
Grass, 10 oz. The produce per acre - - - - - - -			108900	0 =	6806	4	0
80 dr. of grass weigh when dry - -	22	0					
The produce of the space, ditto - -	44	0	29947	8 =	1871	11	8
The weight lost by the produce of one acre in drying - - - -			4934	8	8		
64 dr. of grass afford of nutritive matter -	2	1					
The produce of the space, ditto - -	5	2½	3828	8 =	239	4	8

The produce of foliage in the spring from this grass, is comparatively nothing, as is the case with the latter-math produce. The root leaves are remarkably short in this species of Canary-grass, and the culms are numerous. At the time of flowering, the produce may be said to consist entirely of culms. It grows naturally in dry sandy places; said to have been first discovered in Great Britain by Mr. Woodward and Mr. Crow, near Swaffham, Norfolk, in 1780. It is also a native of Germany, where it grows in pastures, orchards, hills, and dry sandy barren places. It is evidently unfit for cultivation in the farm, as the above produce constitutes what it yields in one season, and which, when compared to that of most other grasses affecting a similar soil, proves greatly inferior. It ripens plenty of seed for its propagation. It thrives best on a sandy loam. The structure of the panicle is useful, to shew the last form of a panicle next to a spike. In this it appears a spike, until pressed by the fingers; it then proves to be a panicle.

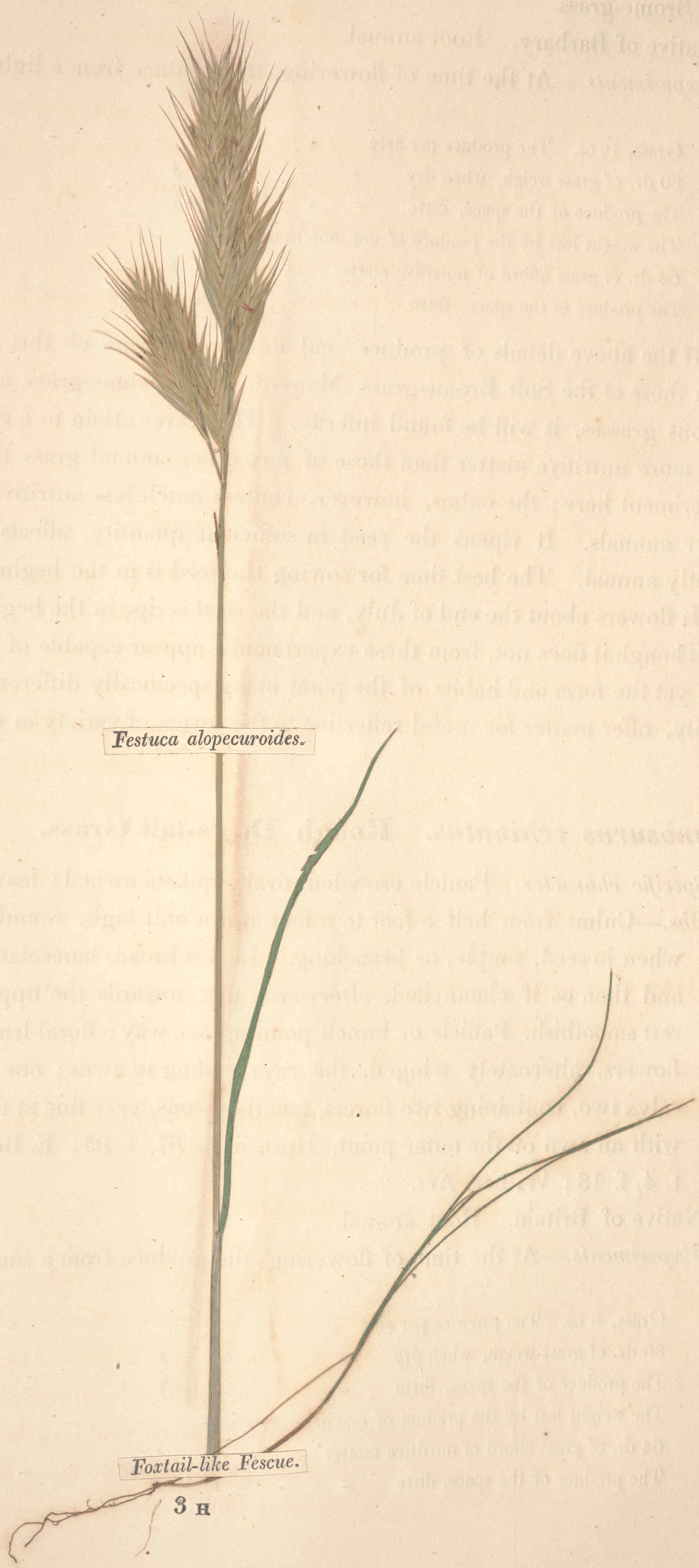
It flowers in July, and the seed is ripe in the beginning of September.

Festuca alopecuroides. Foxtail-like Fescue-grass.

Bromus alopecurus. Donn's Catalogue.

Specific character: Spike erect, attenuated; calyx-valves very unequal, outer large, three-nerved, acuminate, inner very minute, awl-shaped; corolla, outer valve awned, pubescent at the edges; inner, two-nerved, slightly ciliate on the nerves.

Obs.—I can find no specific description of this grass. I received the seeds from Mr. Donn, and there is therefore no doubt of its being the *Bromus Alopecurus* of the Cambridge Catalogue. It proves to be a *Festuca.* Culms smooth, upright; leaves linear, channelled, or doubled together like those of the *Avena pratensis*, and like them, slightly glaucous, smooth; sheath smooth, furrowed, sheath-scale minute lacerated;—spike mostly facing one way, upright;—calyx 10-flowered, terminating floret barren; larger valve of the blossom furnished



Festuca alopecuroides.

Foxtail-like Fescue.

with long, straight, flat-laying hairs at the edges, which distinguish it from every other species of Fescue with which I am acquainted. The long, linear, channelled, smooth glaucous leaves, distinguish it at first sight from the different annual species of Fescue, or Brome-grass.

Native of Barbary. Root annual.

Experiments.—At the time of flowering, the produce from a light siliceous sandy soil, is,

	dr.	qr.	oz.		lbs.		
Grass, 12 oz. The produce per acre - - - - - -			130680	0 =	8167	8	0
80 dr. of grass weigh, when dry - -	32	0	- - 41985	0 =	2624	2	0
The produce of the space, ditto - -	76	3⅕					
The weight lost by the produce of one acre in drying - - - -					5543	6	0
64 dr. of grass afford of nutritive matter -	2	2	- - 5104	11 =	319	0	0
The produce of the space, ditto - -	7	2					

If the above details of produce and nutritive powers of this Annual Fescue be compared with those of the Soft Brome-grass, Many-flowered Brome-grass, and others of the annual indigenous grasses, it will be found inferior. The leaves attain to a considerable length, and contain more nutritive matter than those of any other annual grass that have been submitted to experiment here; the culms, however, contain much less nutritive matter than those of most other annuals. It ripens the seed in sufficient quantity, affects most a light rich soil, and is strictly annual. The best time for sowing the seed is in the beginning of May.

It flowers about the end of July, and the seed is ripe in the beginning of September.

Though it does not, from these experiments, appear capable of being put to any agricultural use, yet the form and habits of the plant being specifically different from all others of the same family, offer matter for useful reflection to the lovers of variety in the vegetable kingdom.

Cynosurus echinatus. Rough Dog's-tail Grass.

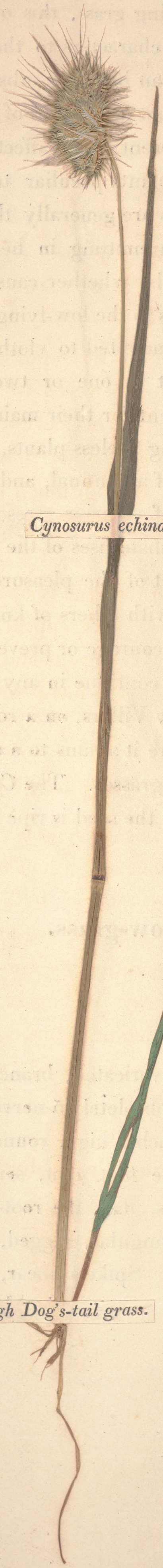
Specific character: Panicle crowded, oval; spikets awned; leaves spear-shaped.

Obs.—Culms from half a foot to a foot and a half high, round, smooth, upper part naked, when in seed, simple, or branching. Leaves broad, lanceolate, at first embracing the stem, and then as if channelled, afterwards flat, towards the upper end and edges rough, the rest smoothish. Panicle or bunch pointing one way; floral-leaves only on the outside of the flowers, alternately winged, the rays ending in awns; one floret in each; husks of the calyx two, containing two florets, membraneous, very fine at the point. Corolla, two valves, with an awn on the outer point. Host. ii. p. 67, t. 95; E. Bot. 1333; Moris. l. c. sect. 8, t. 4, f. 13; Wither. Arr.

Native of Britain. Root annual.

Experiments.—At the time of flowering, the produce from a sandy loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 8 oz. The produce per acre - - - - -			87120	0 =	5445	0	0
80 dr. of grass weigh, when dry - -	24	0	- - 26136	0 =	1633	8	0
The produce of the space, ditto - -	38	1⅗					
The weight lost by the produce of one acre in drying - - - -					3811	8	0
64 dr. of grass afford of nutritive matter -	2	1	- - 3062	13 =	191	6	13
The produce of the space, ditto - -	4	2					



Cynosurus echinatus.

Rough Dog's-tail grass.

This grass is not common; it is found in a wild state near Sandwich, and in the Isle of Jersey, on a sandy soil. It is also a native of Germany, growing in pastures, corn-fields, and on sands by the sea-side. Like the preceding grass, this one is evidently of more use in shewing the diversity of form that gives specific characters to the individuals composing a genera, than to any agricultural purpose to which it can be made subservient; as the above results of experiments made upon it, put every idea of that nature out of the question.

It is a common observation, that different plants affect peculiar soils; or it may, perhaps, be said, that every different soil produces plants peculiar to itself. When soils are first formed from the decomposition of rocks, mosses are generally the first vegetables they produce; afterwards grasses. Nature appears ever unremitting in her efforts to cover every description of soil with grass. And the varieties of soils, whether caused by a difference of internal composition, or of local situation, from the Alps to the low-lying marsh, are very numerous; and the number of species and varieties of grass adapted to clothe them, proportionally great. There are some species of grass that attain but to one or two inches in height, others many feet, according as the soil has richness sufficient for their maintenance and production. These diminutive, and, to the Agriculturist, seeming useless plants, by the yearly death and decay of their leaves and culms, or of the plant itself, if an annual, and by attracting animals to the spot, prepare the soil for the future production of superior grasses. Though a grass therefore may be, comparatively, of no value for the immediate uses of the Farmer, nevertheless, it is not, surely, unworthy of his regard; for independent of the pleasure which a consideration of its peculiar structure, design, uses, and connection with others of known value must excite, a knowledge of the plant, will also direct whether to encourage or prevent its growth in such situations where it is found. Few grasses will thrive or continue in any soil but that which naturally produces them. The present grass was found by Villars, on a rock, where it did not exceed three inches in height; and also in corn-fields, where it attains to a considerable height. This is more general with the annual, than the perennial grasses. The *Cynosurus echinatus* is strictly annual.

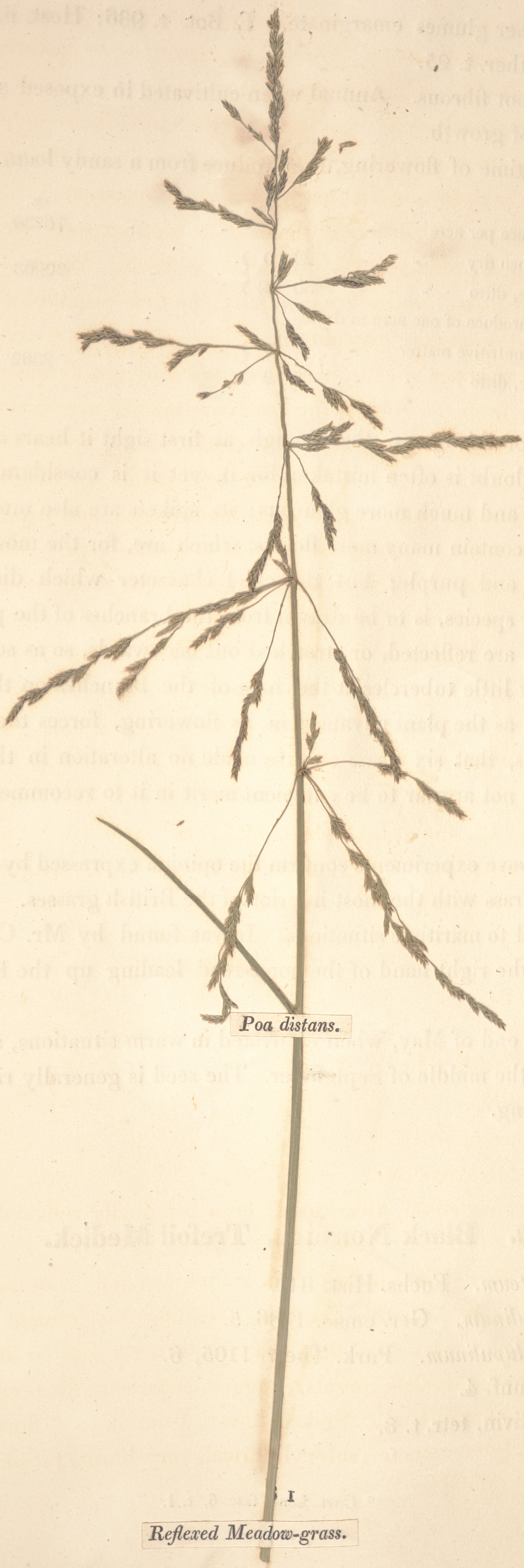
Flowers about the end of June, and the seed is ripe in August.

Poa distans. Reflexed Meadow-grass.

Poa retroflexa. Curtis. Lond.
Poa salina. Pollich. pal. n. 92.
Aira aquatica. B. Huds. Angl. 34.

Specific character: Panicle equal, divaricated; branches finally reflexed; spikets linear, five-flowered; florets blunt, distant, obsoletely 5-nerved.

Obs.—Culms from six to eighteen inches high, round, striated, smooth, obliquely ascending, procumbent from the base to the first joint, sending out branches. Leaves with long sheaths, sharpish, even, glaucous, flat; the root-leaves a little rolled in. Panicle erect, with the branches in half whirls, angular, rugged, somewhat flexuose, branches of various lengths; finally, much bent back. Spikets linear, from 4 to 7-flowered, variegated with white or purple. Florets remote, sub-cylindrical, very blunt, retuse, 5-nerved, scariose at



Poa distans.

I

Reflexed Meadow-grass.

the tip, with the inner glumes emarginate. E. Bot. t. 986; Host. ii. p. 46, t. 63; Curt. Lond. fasc. 61; Wither. t. 25.

Native of Britain. Root fibrous. Annual when cultivated in exposed situations. Perennial in its natural place of growth.

Experiments.— At the time of flowering, the produce from a sandy loam, is,

	dr.	qr.		oz.		lbs.		
Grass, 7 oz. The produce per acre - - - -				76230	0 =	4764	6	0
80 dr. of grass weigh, when dry - -	22	0	-	20963	4 =	1310	3	0
The produce of the space, ditto - -	30	3 1/5						
The weight lost by the produce of one acre in drying - - - -						3454	3	0
64 dr. of grass afford of nutritive matter -	2	0	-	2382	3 =	148	14	3
The produce of the space, ditto - -	3	2						

Mr. Curtis observes of this grass, that though at first sight it bears a near resemblance to the *Poa annua*, and no doubt is often mistaken for it, yet it is considerably taller, its leaves narrower in proportion, and much more glaucous; its spikets are also much narrower, as well as longer, and of course contain many more florets, which are, for the most part, prettily variegated with pale green and purple; but the chief character which distinguishes this from *Poa annua*, and all other species, is to be drawn from the branches of the panicle; these, as the plant goes out of bloom, are reflected, or stretched out backwards, so as sometimes to touch the culm; this is effected by little tubercles at the base of the branches on their upper side only, which increasing in size, as the plant advances in its flowering, forces them backwards*. Mr. Curtis further informs us, that six years culture made no alteration in the appearance of this grass, and that there did not appear to be sufficient merit in it to recommend it for agricultural purposes.

The results of the above experiments confirm the opinion expressed by Mr. Curtis, and rank the Reflexed Meadow-grass with the most inferior of the British grasses. It is chiefly, though not exclusively, confined to maritime situations. It was found by Mr. Curtis in 1786, among the grassy herbage, on the right hand of the horse-road leading up the hill of Hampstead, in tolerable plenty.

It flowers about the end of May, when cultivated in warm situations, and continues to send up flowering culms till the middle of September. The seed is generally ripe in about six weeks after the time of flowering.

Medicago lupulina. Black Nonsuch, Trefoil Medick.

Trifolium pratense luteum. Fuchs. Hist. 819.
Trifolium luteum lupulinum. Ger. emac. 1186, 5.
Trifolium montanum lupulinum. Park. Theat. 1105, 6.
Meliotus minus. Brunf. 4.
Meliotus minima. Rivin. tetr. t. 8.

* Curt. Lond. fasc. 6, t. 1.

Medicago lupulina.

Black Nonsuch.

Specific character:—Spikes oval; seed-vessel kidney-shaped, with one cell and one seed; stems trailing.

Obs.—Stems trailing, unless supported by the plants with which it grows; about a foot long, somewhat angular, slightly hairy, branched. Leaves obovate, or wedge-shaped, toothed towards the top, the mid-rib lengthened out into a short broad point, soft, pubescent, particularly on the under side. Flowers small, yellow, from thirty to forty, and upwards, in a head, which is at first roundish, afterwards oval. Legume striated and wrinkled, somewhat hispid with rigid hairs, turning black when ripe. Seed ovate, smooth, yellowish. Curtis; Woodward; Wither. Arr.; E. Bot. 971; F. Dan. 992. This plant has such general resemblance to the proper Trefoils or Clovers, that it is often mistaken for some of the smaller species. The form and colour of the seed-pods afford a ready mark of distinction.

Native of Britain. Root annual; in some situations biennial.

Experiments.—At the time of flowering, the produce from a sandy loam, is,

	dr.	qr.		oz.		lbs.		
Grass, 20 oz. The produce per acre - - - - -				217800	0 =	13612	8	0
80 dr. of grass weigh, when dry -	30	0	- -	81675	0 =	5104	11	0
The produce of the space, ditto - -	120	0						
The weight lost by the produce of one acre in drying - - - - - - -						8507	13	0
64 dr. of grass afford of nutritive matter -	3	0	- -	10209	6 =	638	1	6
The produce of the space, ditto - - -	15	0						

We are informed, in Mr. Young's Annals of Agriculture, that this plant has been much sown of late years for sheep food in open fields, where it is a considerable improvement, first, for the sweet food, and then, to help the land by ploughing it in, getting a good crop of wheat after it on indifferent soils. Mr. Zappa, of Milan, says, that it likes deep ground, rich, and exposed to the sun; multiplies very well from the seed, grows chiefly in the spring, flowering at the beginning of May, and ripening the seed at the beginning of June; it grows but little towards the end of summer and autumn. It is cut with *Poa trivialis*, fifteen inches high, but is naturally procumbent. The seed of this plant falls so readily, that great loss ensues from moving it, and, in thrashing, the least stroke clears it. It is a good way, therefore, to thrash it in the field on a cloth, which is moved to the seed, and not the seed to the cloth. This account, extracted from Mr. Young's Annals, perfectly agrees with what I have observed of the habits of this plant, only that it does not flower here till the middle or end of May. For light soils only it appears to be adapted, and these must be deep, as the root penetrates to a considerable depth, and is but little fibrous. It does not appear fit for separate cultivation, nor even to be employed in a large proportion, in a mixture of other seeds. The root is annual, or at most a two-year lived plant, and its use is therefore confined to the alternate husbandry. To sow the seeds of this plant with others, on land intended to remain for permanent pasture, would be subversive of the intention; as every spot this plant occupied would be naked the second year, and these spots afford every encouragement to the growth of weeds, as well as the decaying roots afford nourishment to the life of grubs.

Hedysarum onobrychis. Sainfoin, or Cock's-head.

Generic character: Keel transversely obtuse; legume jointed, with one seed in each joint.

Specific character: Legumes one-seeded, prickly; wings of the corolla equal in length to the calyx; stem elongated.

Obs.—Stems round, striated, at first procumbent, in flower ascending. Stipules in pairs, oval-lanceolate, terminated by a long point with membranaceous edges, sometimes fringed with a few hairs. Leafets eight or ten pairs, rather distant, and an odd one; lower eliptical, upper lanceolate or linear-lanceolate, all with projecting points at the end; young ones with the mid-rib beneath, and the margins fringed with hairs. Legume hemispherical, compressed with wrinkled prominences. Wood. MSS.; E. Bot. t. 96; F. Rust. t. 47; Huds. 322; Jacquin. t. 352; Park. Theat. 1082, 1, *Caput gallinaceum.*

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a poor siliceous sandy soil, is,

	dr.	qr.		oz.		lbs.	
Grass, 10 oz. The produce per acre - - - -				108900	0 =	6806	4 0
80 dr. of grass weigh, when dry -	25	0	- -	34031	4 =	2126	15 4
The produce of the space, ditto - -	50	0					
The weight lost by the produce of one acre in drying - - - -				4679		4	12
64 dr. of grass afford of nutritive matter -	3	0	- -	5104	11 =	319	0 11
The produce of the space, ditto - -	7	2					

At the time the seed is ripe, the produce from a rich clayey loam, is,

Grass, 13 oz. The produce per acre - - - -				141570	0 =	8848	2 0
80 dr. of grass weigh, when dry - -	32	0	- -	56628	0 =	3539	4 0
The produce of the space, ditto - -	83	$0\frac{1}{5}$					
The weight lost by the produce of one acre in drying - - - - -				5308		14	0
64 dr. of grass afford of nutritive matter -	2	2	- -	5530	0 =	345	10 0
The produce of the space, ditto - -	8	$0\frac{1}{2}$					

The produce of Sainfoin on a clayey loam with a sandy subsoil, is greater than on a siliceous sandy soil incumbent on clay; but the nutritive powers of the herbage produced on the sandy soil is greater.

	dr.	qr.
The nutritive matter afforded by Sainfoin from a given space of a clayey loam, is - -	8	$0\frac{1}{2}$
The nutritive matter afforded by the Broad-leaved Clover from an equal space of the same soil, is	45	0
The nutritive matter afforded by Sainfoin from a siliceous sandy soil, is - - - -	7	$0\frac{2}{4}$

The superior value of Sainfoin for soils on a porous or dry subsoil, is therefore manifest.

Sainfoin grows wild in all the chalky districts in England; but it was first introduced to English Farmers as a plant for cultivation from Flanders and France, where it has been long cultivated. Parkinson, in the year 1640 says, that it is "generally known to be a singular food for cattle, causing them to give store of milk."—Woldridge, in his Mystery of Husbandry, &c. (1681), treats of Sainfoin at large: "In Wiltshire, in several places," says he, "there are precedents of Sainfoin that has been there twenty years growing on poor land, and has so far improved the same, that from a noble per acre, twenty acres together have been certainly worth thirty shillings per acre, and yet continues in good proof."—These extracts shew the high opi-

nion which was entertained of this plant above one hundred years ago; but this was, no doubt, in a great measure owing to the small number of plants then known for sowing in the farm.

The experiments that have here been made on this plant, were confined to a clayey loam and a light siliceous soil. Upon these it was evidently inferior to the Broad-leaved, and Perennial Red Clover; but on chalky and gravelly soils there have been abundant proofs of the superior value of Sainfoin. After the ample details of the uses and cultivation of Sainfoin given in Mr. Young's Annals, it will be difficult to add any thing new. It is a perennial plant, and produces but little herbage the first year, and on that account should not be sown on land that is intended to remain only two years under grass. In Mr. Young's Annals we are informed, that Sainfoin is allowed on all hands to be an admirable improvement on limestone rocks and chalk downs, which, in order to be cultivated to the greatest advantage, should be in this course, with no more arable than is necessary for the change. Thus if Sainfoin last sixteen years, as it certainly will, if properly managed, then sixteen parts of the down should be Sainfoin, and as many more parts as there are years necessary for tillage, before the ground should be sowed with it again: suppose this period to be five years, the portions would then be 10 Sainfoin; 1. Sainfoin pared and burnt, and under Turnips; 1. Barley or Oats; 1. Clover; 1. Wheat; 1. Turnips; 1. Barley or Oats, and with this crop Sainfoin sown again = 16. In another part we are informed, that Sainfoin is also a great improvement in thin, loose, dry, sandy loams, upon marl or chalk bottoms.

Thin soils that wear out, or tire of Clover, are laid down to great advantage with it, will last twenty years, and pay the Farmer as well as his best corn crops. If a flock of sheep be an object of primary importance, this plant will afford them plenty of dry food, for winter in hard weather. An acre of indifferent land will yield two tons of Sainfoin dry, and therefore twenty acres will serve 1000 sheep for a month, supposing a sheep eats three pounds of hay in a day, which is a large allowance. Now the expence of an acre of Sainfoin, including fourteen shillings for rent, tithe, and poor, is about one pound; whereas that of an acre of Turnips will be two pounds seven shillings. Eight acres and a half of Turnips, then, balance twenty acres of Sainfoin. Now 1000 sheep will eat two acres and a half of Turnips in a day, and therefore seventy-five acres will be required for a month: or at the lowest calculation, twenty-four acres; the expence of which is £56 : 8*s*. to be set against £20, the expence of Sainfoin*.

* Besides the grasses and other plants, that have been mentioned in this series, there are a variety of different plants, which form a part of the produce of dry sandy rough pastures; the principal of which will now be briefly noticed.

1. *Carduus acaulis.* Dwarf Thistle. E. Bot. 161; Flo. Dan. 1114.—A dwarf plant, but spreading to the breadth of a foot. The leaves grow close to the ground, are very prickly, and prevent cattle from browsing near them. Though it appears to be only a biennial plant, it is certainly one of the most pernicious weeds in these soils; being suffered to grow in hedge-rows, and in the corners of fields, the ordinary means of destroying it in the body of the pasture, by mowing, is rendered ineffectual. Mowing, or stocking up Thistles, is only a palliative remedy; but it may be rendered more effectual with respect to the destruction of the annual and biennial Thistles, by suffering them to grow till near the period of their coming into flower, before they are cut; because, when mown at an earlier stage of their growth, they continue to send out suckers during the rest of the season, and consequently require an endless repetition of mowing, without fulfilling the intention. But the only remedy is to break up the pasture, and improve it by a judicious course of crops, which includes the application of clay, if the soil be sandy; and proper manuring. All this, however, will be ineffectual, if the surrounding hedges and waste places are neglected.

2. *Anthemis nobilis.* Common or Sweet Chamomile. E. Bot. 930; Wood. Med. 103.—A perennial, flowering in July and August, well known for its use in medicine. It is observed, that the single flowers are far superior to the double

It flowers about the middle and towards the end of June. The seeds are large, and when sown in wet soils, generally burst and rot without vegetating. There is some difference of

ones, which are cultivated in gardens, and sold in the shops. I never could observe that any part of this plant was touched by cattle.

3. *Antirrhinum linarea.* Common Toad Flax, or Butter and Eggs. Curt. Lond. Eng. Bot. 658; Flo. Dan. 982.—A perennial plant, more common by the sides of fields than in the body of the pastures. Dr. Withering says, that an infusion of the leaves is diuretic and purgative; and an ointment prepared from them gives relief in the piles. The expressed juice mixed with milk, is a poison to flies, as is likewise the smell of the flowers. Cows, horses, and swine refuse it; sheep and goats are not fond of it.

4. *Erica vulgaris.* Common Heath; called Ling in England, and Heather in Scotland. Curt. Lond. 297; E. Bot. 1013; Flo. Dan. 677.—When dry pastures abound with this plant, they take the name of Heaths. It can only be extirpated by paring and burning, and converting the pasture into tillage; this has been effected with profit, by several occupiers of such land in Scotland and England. It is the most valuable material for the construction of bush-drains. Bees extract honey largely from the flowers, which is of good quality, but of a reddish colour. In the Highlands of Scotland, the poorer inhabitants make walls for their cottages with alternate layers of Heath, and a kind of mortar, made of black earth and straw; the woody parts of the Heath being placed in the centre, and the tops externally and internally. They make their beds of it, by placing the roots downwards, and the tops uppermost; they are sufficiently soft to sleep upon. Scott says—

> "———— the stranger's bed
> Was there of mountain heather spread,
> Where oft an hundred guests had lain,
> And dreamed their forest sports again;
> Nor vainly did the heath-flowers shed
> Its moorland fragrance round his head."

They also use it for thatch. In the island of Ilay, Ale is often made by brewing one part of Malt, and two parts of the young tops of Heath; sometimes they add Hops. Boethius relates, that this liquor was much used by the Picts. Sheep and goats will sometimes eat the tender shoots, but they are not fond of them. Cattle, not accustomed to browse on Heath, Linnæus says, give bloody milk at first, but are soon cured, by drinking plentifully of water. The branches of Heath afford shelter; and the seeds, a principal part of the food of many birds, especially those of the grous kind; and the seed-vessel is formed in such a manner, that the seeds are preserved the whole year, and even longer. In the north of Scotland, ropes are made of it, as strong, as durable, and nearly as pliant, as Hemp. Consult Pen. Tour; Garnet's Tour; Light. Scot.; Withering, &c.

5. *Bunium bulbocastanum.* Earth-nut, Pig-nut, Yer nut. E. Bot. 988.—A perennial plant, with a tuberous root. Swine are fond of the roots; cattle do not appear to touch the leaves or branches. Being a diminutive plant, it is not much to be feared as a weed.

6. *Campanula rotundifolia.* Common Bell-flower, Witches' Thimble. E. Bot. 866.—There is hardly a plant that indicates more the extreme barrenness of a soil, than this. It is a perennial, flowering in July and August; the flowers are blue, sometimes nearly white.

7. *Centaurea calcitrapa.* Star Thistle. E. Bot. t. 125.—This is a biennial plant, and a very troublesome weed. It is frequent by road-sides, as well as in dry rough pastures. The flowers are at first a deep red. It flowers in July and August. It may be overcome by the same means as was recommended for the Dwarf Thistle.

8. *Chrysanthemum leucanthemum.* Ox-eye Daisy, Moon Flower, Maudlin Wort. E. Bot. 601.—This plant is a perennial, and flowers in June and July. It propagates by the root, and extensively by the seed. There are no means of extirpating it from dry pastures, but by converting the land into tillage for several years, and keeping the hedge-rows, path-sides, &c. perfectly clean during the course of crops.

9. *Conzya squarrosa.* Great Fleabane, Ploughman's Spikenard. Eng. Bot. 1195.—A biennial plant, very common on dry sandy pastures, but more particularly on converted heaths; and there constitutes the most troublesome weed. The plant is covered with white woolly hairs, which make it conspicuous; it grows from two inches to two feet in height, according to the depth of the soil in which it is produced: in hedges it attains to the greatest height. It will be found a vain attempt to subdue this plant, if the hedges and path-sides are suffered to produce and foster it. The seed is produced in abundance, and being light, is easily dispersed by the wind. It flowers in July and August. Its dwarf size, when in poor soils, and the peculiar struc-

opinion with respect to the best season for sowing; according to several trials that I have made, the middle or end of April is the most certain; but when sown in the autumn, unless the soil

ture of the plant, render the scythe of little or no use in destroying it. Its presence denotes a great degree of sterility in the soil that encourages its growth. The application of clay or marl will be found the best remedy, as this weed will soon disappear of itself.

10. *Galium verum.* Yellow Ladies' Bedstraw, Cheese Renning, Petty Muguet, Yellow Goose-grass. E. Bot. 660.—A perennial, flowering from June till October, more common in the hedges and way-sides than in the body of pastures. It is said the flowers will coagulate boiling milk. The French prescribe them in epileptic and hysteric cases. Boiled in alum-water, they tinge wool yellow. The roots dye a fine red, not inferior to madder, and are used for this purpose in the island of Jura. Sheep and goats eat it; horses and swine refuse it; cows are not fond of it. Withering; Pennant, p. 214.

11. *Cucubalus baccifer.* Bladder Campion, Spattling Poppy, White Bottle. E. Bot. 1577.—A perennial, more common in corn-fields than in pastures. It grows from one to three feet in height, the flowers are white, and the calyx inflated, veined like a net with green. Great care should be taken to prevent it from seeding, and the roots should be taken up.

12. *Euphrasia officinalis.* Common Eyebright. E. Bot. t. 1416.—A small annual plant with blue flowers. It resembles Chickweed in its manner of growth, and is nearly as difficult to extirpate as that weed; like the Ploughman's Spikenard, it indicates sterility of land, similar to that caused by injudicious cropping, and is only to be overcome by enriching the soil under a judicious course of crops cultivated in rows, by which this, and all other weeds, are easily overcome. It flowers from July till October.

13. *Geranium.*—Of this there are several species, common to sandy pastures. They are diminutive weeds, and little evil results from their presence; they generally disappear after the soil has been in tillage two or three years under good management; and the soil enriched, by having its texture altered, from the addition of clay or marl.

14. *Hypochæris radicata.* Long-rooted Hawk-weed. E. Bot. 831.—A perennial, with yellow flowers; grows from four inches to two feet in height, according to the quality of the soil. The roots are long, and often the thickness of the little finger. It was offered to sheep and cows, but they refused it. It flowers from June till August.

15. *Jasione montana.* Hairy Sheep's Scabious, Scabious Sheep's-bit. E. Bot. 882.—An annual plant, with blue flowers and hairy leaves. It is to be found chiefly in very dry soils. It contains a milky juice; is said to be eaten by sheep; but they refused it in one trial that I made. It flowers from June till August.

16. *Veronica officinalis.* Common or Male Speedwell or Fluellin. E. Bot. 765.—A perennial plant; flowers in May and August. The flowers are of a purplish blue colour. It is said that horses, goats, and sheep, eat it. An infusion of the leaves is recommended by Hoffman as a substitute for tea; but it is more astringent and less grateful. *(Withering.)*—It is never found in such abundance as to render it a formidable weed. It soon disappears under a judicious system of tillage.

17. *Thymus serpyllum.* Wild Thyme, Mother of Thyme. E. Bot. t. 1514.—A perennial, common on all dry sandy soils, particularly on ant-hills. There is some difference of opinion with respect to cattle eating this plant; its dwarf growth rendering the point difficult to ascertain. I offered different quantities of this plant to South Down and Welsh sheep, but they uniformly rejected it. Dr. Withering says that it yields an essential oil, which is very heating, and that an infusion of the leaves removes the head-ache occasioned by the debauch of the preceding evening. The *Phalæna papilionaria* lives upon it.—Paring and burning the ant-hills during summer, would occasion the destruction of the ants; when this operation is done during the winter, or cold months, it is seldom effectual, as the ants are then in secure quarters below the base of their hills, and therefore receive but little, if any injury, from the effects of the paring and burning. Hot, or caustic lime, should be applied to the scites of the hills after they are burnt, and the ashes scattered on the surface, which would complete the remedy.

18. *Tormentilla erecta—officinalis.* Curt. Lond. 337. Sept Foil.—A perennial, flowering in June and September. The flowers are of a fine yellow colour; the straws are at first trailing, afterwards ascending; the leaves are of a fine green colour. The roots are powerfully astringent; they are used, Dr. Withering informs us, in several counties to tan leather, and that Farmers find them efficacious in the dysenteries of cattle. They dye red. Goats, sheep, and swine eat the plant; horses refuse it.—*(Linn.)*

19. *Rumex acetosella.* Shee's Sorrel, or Dock. E. Bot. 1674; Flo. Dan. 1161.—A perennial plant, flowering in May and June. It is very diminutive in dry sandy pastures; the leaves grow close upon the surface of the soil, and they are generally of a deep red colour, caused by the drought. I have observed that it was sometimes cropped by sheep and hares; but in these instances there appeared always a great scarcity of other herbage. Like every other species of Dock, it is with difficulty over-

be favourable, many of the plants are lost during the winter; should circumstances prove otherwise, the autumn sowing will be found the most advantageous, as it affords nearly a full crop in the ensuing season*.

It was before observed, that dry thin sandy pastures are the least capable of improvement, from the defect in the constitution of the soil, which arises from the want of clay and marl. The process of paring and burning, which is so efficacious in converting bogs and rough tenacious clays, is found to injure thin sands; yet, without this process of burning the surface, the crops that follow the ordinary mode of breaking up such soils by the plough only, are devoured by insects at the roots, and seldom repay the expence of labour.

The comparative disadvantages which attend the ordinary mode of converting thin sandy pastures into tillage by ploughing only, are found by experience, to be far greater than those which result to the soil by the process of burning. Sir Humphry Davy says, that "the process of burning renders the soil less compact, less tenacious, and retentive of moisture;" burning, therefore, increases the natural defects of sandy soils, and lessens the quantity of soluble vegetable matter they contain. It seems probable, however, that the process of burning may be conducted in such a manner as to prevent any diminution of the original quantity of soluble vegetable matters contained in the soil. For when the parings or turfs are submitted to the fire, they should only be burnt till the ashes are black, and will then contain carbonaceous matter, which will be found to afford more soluble vegetable matter than the soil originally contained. But when the parings are burnt till the ashes are red or white, the carbonaceous matter is destroyed, and the ashes that remain will be found to consist of oxides, and saline matters of little value to such soils. With respect to tenacious clayey soils, the case is directly the reverse: these cannot be too much burnt, by the ordinary process of burning, as the object here is not so much to destroy insects and the seeds of noxious plants, as to correct the texture of the soil, by rendering it more friable, and less tenacious or retentive of moisture.

It is evident that the application of clay or marl, and vegetable manure, even in small quantities, will compensate the soil for the greater division of its parts and loss of decomposing vegetable matter, let the process of burning be conducted in what manner it may; but there are no remedies at present known, for the prevention or even palliation of the ravages of the wire-worm, grubs, and other voracious insects with which these soils generally abound, except that of burning, which, when properly effected, experience has proved to be effectual to their destruction.

In Scotland and in England I have witnessed the practice of converting rough pastures, con-

come on its natural soil; till by good management, under tillage begun with paring and burning the surface, and by adding clay or marl, a permanent change is effected in the nature of the soil.

20. *Polygonum aviculare.* E. Bot. 1252. Knot-grass, Snake-weed, Red-weed.?—This is a biennial plant, flowering from April to October. It is one of the most noxious weeds that infest dry sandy soils, and even on rich soils, under judicious cropping, it is often met with; so difficult it is to destroy it, when once the roots get established in light soils. The seeds appear to be as grateful to birds as those of buck-wheat, *(Polygonum fagopyrum).* There appears to be nothing which encourages the growth and propagation of this weed, so much as severe cropping with successive white grain crops, and the neglect of the row or drill mode of cultivation.

> "The knot-grass fetters there the hands,
> That once could have burst iron bands." SCOTT.

* Young's Annals, viii. p. 73; ii. p. 360.

taining heath, furze, and coarse grasses, by first burning the plants on the surface while growing, and then ploughing the land for a course of crops. By this, it invariably happened that the land soon became stocked with its original unprofitable plants, as their seeds and roots were securely preserved in the turf while the plants themselves were burning.

In the Essays published by the Board of Agriculture, (Communications, vol. iv.), a variety of facts are brought forward, which go to prove the great increase of value which these pastures are capable of receiving by a proper mode of converting them into tillage.

Mr. Stephen Kershaw states, in his experiments, the increase of value in thin-skinned warren, when converted into tillage by previously paring and burning, to be from thirteen pence per acre, the original value, to six or eight shillings per acre.

Mr. Wright of Pickworth, after describing several failures in attempting to convert "a tract of poor light barren heath by the ordinary mode of breaking up with the plough, states the complete success which attended his endeavours on another tract of the same soil by paring and burning." This ground, Mr. Wright says, "produced an excellent quality of turnips, value £2 : 10 : 0 per acre. I afterwards," continues he, "sowed with barley on one ploughing in March; the crop was estimated at five quarters per acre throughout the piece; clearing to me as much in one year, as it would have done in pasturage, in its original state, in a century."—Mr. Wright recommends the following course of crops: First year, pare and burn, and sow with turnips; second year, barley; immediately after the barley crop plough once, and harrow in winter tares, to be mown for soiling stock of all kinds on the same ground, which may be begun about the third week of May, and continue till the seed in the pod is nearly ripe, perhaps in July; what then remains unconsumed may be made into excellent hay. After this, on one ploughing to sow turnips, with or without manuring. After the turnips, barley with grass-seeds, either to remain one, or many years.

Mr. Legard, of Gratton, observes, that paring and burning, when regard is had to subsequent cropping, is advantageous, because it generally ensures a crop of turnips, the foundation of all good husbandry; and in light soils, the advantage of eating the turnip crop upon the land is very great, and should therefore be invariably practised.

Other statements, equally satisfactory, might be brought forward, but they all agree in principle—to break up dry rough sandy pastures by paring and burning; white crops seldom, at the most one white crop to two green crops. In the preparation of the land for these crops, the scarifier should be frequently employed instead of the plough, as the frequent turning up of such soils becomes more injurious than beneficial.

From the foregoing series of facts and observations, respecting the different grasses and other plants which compose the produce of dry upland pastures, it may fairly be inferred, that these plants are not susceptible of that degree of improvement by cultivation, which would fit them for the support of the larger domestic animals. Sheep may be considered the only stock that can be profitably maintained on such pastures. Still, however, their natural state may be much improved by frequent top-dressings with manure or compost, and at the same time, by sowing the seeds of the grasses which will be mentioned hereafter. The roller should be often used; the inferior grasses should not be suffered to perfect or shed their seeds; and the pasture should be closely cropped. By persevering in this mode of treatment, a superior pasture would soon be obtained.

But these improvements, effected on poor siliceous sandy pastures, by the above treatment, will be found only temporary; and that, as soon as the means are suspended, the pasture will return again to its former inferior state; this kind of soil being of a nature that soon exhausts the manure applied to it, whether on the surface as a top-dressing, or when ploughed in the land. It will be found absolutely necessary to change first the nature of the soil, by the application of clay or marl; and the superior grasses will then keep possession of the soil, even under indifferent management. There will be much less occasion for manure, and the quantity applied will have double the effect. The land, by this means, is improved permanently. It is much to be lamented, that pastures of this nature are often broken up, undergo a course of crops, and are again returned to grass, without any change being made in the nature of the soil. If marl be often out of reach, clay seldom is, as this earth is generally found under sand, or in its neighbourhood. Before clay, marl, or any ingredient that effects a permanent change in the nature of a soil, be applied, the nature of the soil, and the ingredient, should first be ascertained by chemical analysis. And the exact quantity of the ingredient, necessary to effect the desired change in the nature of the soil, will, by this, be accurately determined. Without this, the operation will be performed in the dark, and consequently with less certain success. If the reader will look back to the observations on soils, stated in the Introduction, he will find some hints on this important point.

Of the different grasses natural to dry siliceous sandy soils, that have been submitted to experiment, and mentioned in the foregoing series, the sheep's fescue, *(Festuca ovina)*; flexuose hair-grass, *(Aira flexuosa)*; common bent-grass, *(Agrostis vulgaris)*; flat-stalked meadow-grass, *(Poa compressa)*; and common bird's-foot trefoil, *(Lotus corniculatus)*, prove to be the best. For dry calcareous soils, on chalky subsoils, the meadow oat-grass, *(Avena pratensis)*; meadow barley-grass, *(Hordeum pratense)*; and crested brome-grass, *(Bromus cristatus)*; will be found the most valuable, if no alteration be made in the nature of the soil.

It has already been observed, that the value of these grasses, even when cultivated in the best manner, are only adapted for the maintenance of sheep; and to introduce the superior pasture grasses on such soils, the previous application of clay or marl is absolutely necessary. When this important point has been effected, to obtain the most valuable sward the soil is capable of producing, the seeds of the following grasses should be sown, and experience will prove, that under such circumstances, they are the best for this purpose.

Cock's-foot grass, *(Dactylis glomerata)*, - - - -	3 pecks.
Cressed dog's-tail grass, *(Cynosurus cristatus)*, - - -	1 ditto.
Yellow oat-grass, *(Avena flavescens)*, - - - - - -	2 ditto.
Rye-grass, Pacey's, *(Lolium perenne)*, - - -	1 ditto.
Flat-stalked meadow-grass, *(Poa compressa)*, - - - -	1 ditto.
Hard fescue, *(Festuca duriuscula)*, - - - - -	2 ditto.
Lesser bird's-foot trefoil, *(Lotus corniculatus)*, - - - - -	1 lb.
White clover, *(Trifolium repens)*, - - - - -	3 ditto.

From a variety of experiments that I have made on a small scale, with a view to ascertain the quantity of seed that would produce the best sward in the shortest space of time; I feel convinced, that any quantity less than five bushels per acre of the above mixture, should not be used, under the circumstances of soil now described.

Barley proves always less injurious to the grasses, when sown with them, than any other of the white grain crops. The nutritive matter of Barley contains more sugar, and proportionally, less gluten or albumen, than any other species of Corn.

The defect of sandy soils in germinating seeds, is clearly owing to the sudden deprivation of moisture which they suffer, when a course of dry weather commences just before, after, or at the time the seed begins to vegetate. For when sandy dry soils are duly supplied with moisture, seeds sown on such, sooner vegetate than on any other kind of soil, whether of a richer or more tenacious nature.

The manner of growth of Tares offers a remedy for the defect of white grain, or upright growing crops. The stems of Tares spread out and shade the surface of the soil from the effects of the sun. But, unless Tares are sown very thin, they will be found to destroy the seedling grasses, by excluding the air. In every instance, however, where the seeds of annuals are sown with the perennial grass-seeds, it should be remembered, that every plant of these occupies a space to the detriment of the expected sward; and the results of all my experiments perfectly agree in confirming the opinion, that for *permanent* pasture, the grasses sown should be free from any admixture of annual, or white grain crops.

The results of all the experiments on light sandy soils, tend to confirm the opinion before expressed at page 95, respecting the superiority of depasturing, or mowing seedling grasses, the first year. Oxen are liable to poach the surface; and horses and sheep weaken the seedling plants, by cropping too near the roots. Sheep are evidently the least hurtful. By frequently rolling the surface, and mowing the produce, the young plants establish themselves better in the ground, and all of the plants raised are preserved. But by leaving the plants to perfect their seed the first year, and excluding cattle, the young plants are deprived of the benefit of the manure supplied by the sheep, which, at this stage of the growth of seedling grasses, is more particularly valuable on a soil of this nature, than on rich ancient pasture land; as the roller, when used judiciously, presses the droppings into the surface of the ground, and brings the manure in contact with the fibrous roots of the plants. It is evident, however, that all the benefits accruing to the plants from depasturing the first year, may be supplied by a top-dressing in the autumn or spring, and a liberal use of the roller, when the ground is in a suitable state to benefit by it. By suffering the seedling plants to perfect their seed before the crop is collected, is doubtless not the best practice: in all my experiments, the results were decidedly in favour of this opinion. A top-dressing should never be applied without sowing some of the seeds along with it; once sowing will never be found efficient to form the most valuable sward in the shortest space of time, on a light dry sandy soil.

Should the mode of depasturing, instead of mowing the first year's crop, be still preferred in any case, I may be permitted once more to remark, that nothing weakens or retards the growth of grasses so much, as cropping them close at the time their first tender shoots appear in the spring. From various trials, it appeared that close cropping the produce of this soil early in the spring, and late in autumn, was much less injurious to its old sward than to seedling grasses. When a given space of the same species of grass was cut close to the roots towards the end of March, and another space left uncropped till the last week in April, the produce of each space being afterwards taken at three different cuttings, the produce of the space that was left uncropped till the latter end of April, exceeded that of the early cropped space, in the proportion of 3 to 2;

in one instance, during a dry summer, the last cropped space afforded a produce superior to that of the early cropped space, as 2 to 1. In all these trials, the produce of the early space consisted of four crops, and that of the later three. It appears therefore, that no stock should be admitted to seedling grasses, till after the time of their coming into flower.

III.

Of the Grasses which naturally grow in Moist Soils, or in Bogs, Lands that are periodically overflown, and Irrigated Meadows.

All the superior pasture grasses will thrive under irrigation, provided the water-meadow be properly constructed; that is, if the water be placed perfectly under command, so as to be admitted on the land, and carried off from it at pleasure.

Bogs and lands that are periodically overflown, on which the water stagnates from the want of drains, support few grasses of any value to the Agriculturist. They are principally the following: Marsh bent, *(Agrostis palustris);* awnless brown bent, *(Agrostis canina,* vel. *Trichodium caninum,* var. *mutica);* awned creeping bent, *(Agrostis stolonifera aristata);* smaller-leaved creeping bent, *(Agrostis stolonifera angustifolia);* creeping-rooted bent, *(Agrostis repens);* white bent, *(Agrostis alba);* flote fescue, *(Festuca fluitans);* tall fescue, *(Festuca elatior);* turfy hair-grass, *(Aira cæspitosa);* knee-jointed foxtail-grass, *(Alopecurus geniculatus);* water hair-grass, *(Aira aquatica);* water-meadow grass, *(Poa aquatica);* long-leaved cotton-grass, *(Eriophorum polystachion);* sheathed cotton-grass, *(Eriophorum vaginatum).*

The above grasses, however, constitute but a small portion of the produce of marshy ground. The following plants compose the bulk of produce: Different species of rushes, *(Juncus);* sedges, *(Carex);* rush grasses, *(Schœnus);* club-rushes, *(Cyperus);* cat's-tail rushes, *(Typha);* bur-weeds, *(Sparganium).* Of all these plants, as far as my observations have extended, two or three species of *Juncus* only, are eaten by cattle. Mr. Taunton indeed says, that he has observed cattle crop some of the species of *Carex.* The natural, or proper grasses, produced on these stagnant lands, are of a very inferior value. The Water-meadow Grass seems the most valuable, as will appear by the following details of experiments made upon them.

To the indigenous grasses natural to marshy and sour clayey lands, mentioned in the following series of specimens, I have added such foreign grasses as may be classed with them.

Agrostis canina, var. *mutica*. Awnless Variety of Brown Bent.

Trichodium caninum muticum. (Schrader.) Creeping-stalked Brown Bent.

Specific character: Panicle branches subdivided, roughish; corolla of one husk, awnless.

Obs.—In the Flora Germanica, this grass is made a variety of the *Agrostis canina* of Dr. Smith. "*Trichodium caninum*, var. *floribus omnibus muticis.*" Flo. Ger. 198. It differs but little from the *Agrostis nivea*, except in the want of the awns and the length of the culms. The structure varies almost imperceptibly in the *Agrostis canina*, *Agrostis nivea*, and in this species. The like gradual shades of difference may be perceived in the colour of the plants: the *canina* is of a brownish green colour; this awnless variety is of a pale green; the *nivea* of a greenish straw colour. The knots or bundles of leaves attached to the decumbent shoots, shew it to be connected with the *Agrostis fascicularis*.

Experiments.—At the time of flowering, the produce from a bog soil, is,

	dr.	qr.	oz.		lbs.		
Grass, 8 oz. The produce per acre - - - -			87120	0 =	5445	0	0
80 dr. of grass weigh, when dry, -	22	0					
The produce of the space, ditto - -	35	$0\frac{4}{5}$	23958	0 =	1497	6	0
The weight lost by the produce of one acre in drying - - - - -			3947	10	0		
64 dr. of grass afford of nutritive matter -	1	3					
The produce of the space, ditto - -	3	2	2382	3 =	148	14	0

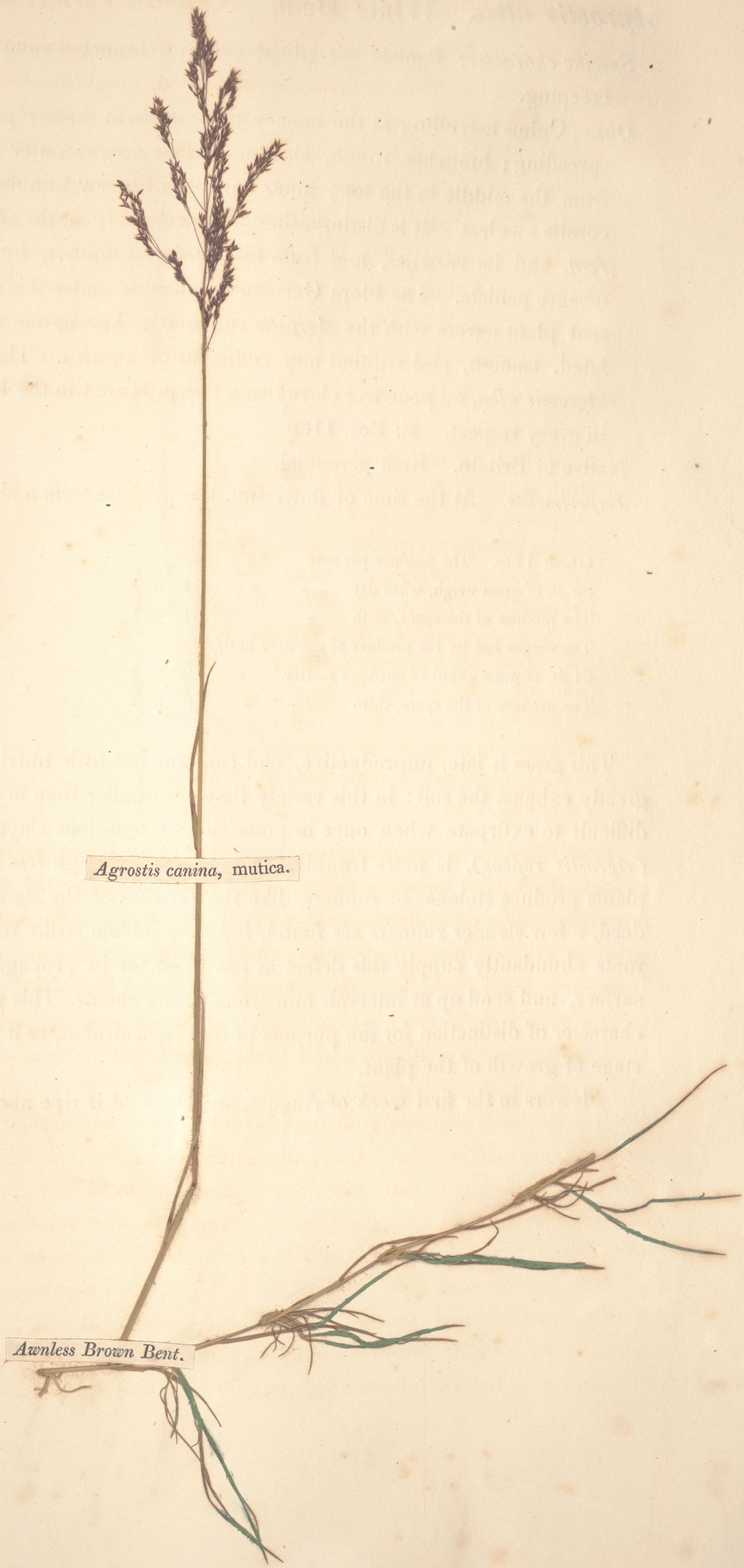
At the time the seed is ripe, the produce is,

	dr.	qr.	oz.		lbs.		
Grass, 9 oz. The produce per acre - - - -			98010	0 =	6125	10	0
80 dr. of grass weigh, when dry - -	34	0					
The produce of the space, ditto - -	61	0^{4}	41654	4 =	2603	5	4
The weight lost by the produce of one acre in drying - - - - - -			3521	4	12		
64 dr. of grass afford of nutritive matter -	2	2					
The produce of the space, ditto - -	5	$2\frac{2}{4}$	3828	8 =	239	4	8

It will have been remarked from the perusal of the foregoing statements, that the stoloniferous grasses afford more nutritive matter at the time, and after the seed is ripe, than at the time of flowering. The decumbent stems, or runners, of the annexed specimen, furnished with tufts of leaves at the joints, illustrate in some measure, the meaning of the term stoloniferous. Sir Humphry Davy says, that the concrete sap stored up in the joints of these grasses, renders them a good food, even in winter. The weight of nutritive matter contained in this grass, at the time the seed is ripe, is superior to that afforded at the time it is in flower, in the proportion of 7 to 10.

It is the most common grass on deep bogs, even where they are subject to be under water for six months in the year. It is a diminutive plant, very unlike the produce of such soils; the leaves seldom attain to more than two or three inches in length. Hares crop the foliage in the spring. The smallness of the produce, even when cultivated under the most favourable circumstances, affords a sufficient proof of its unworthiness to be regarded by the Farmer, in any other light than that of a weed which indicates a soil capable of being improved so, as to produce the most valuable grasses by artificial irrigation. It may be propagated to any extent by seeds, or by planting the stolones, or decumbent-rooting shoots.

Flowers in the second and third weeks of July, and ripens the seed about the middle of August.


Agrostis canina, mutica.
Awnless Brown Bent.

Agrostis alba. White Bent.

Specific character: Panicle spreading, meagre, branches roughish; culms decumbent; root creeping.

Obs.—Culms ascending at the base, afterwards bent down; panicle, when in flower, widely spreading; branches rough, slender; leaves rough; outer valve of the calyx serrulated from the middle to the top; inner valve with a few minute serrulatures towards the top; corolla awnless. It is distinguished at first sight from the *Agrostis repens, Agrostis stolonifera,* and its varieties, and from the *Agrostis palustris,* by its decumbent culms and thin meagre panicle. The Flora Germanica includes under this name five varieties. The present plant agrees with the *Agrostis vulgaris,* in having one valve of the corolla only serrulated, smooth, and without any rudiment of an awn. This is a common variety of the *Agrostis alba,* on poor wet clayey soils: that figured in the English Botany, is much larger in every respect. E. Bot. 1189.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a clayey soil, is,

	dr.	qr.		oz.		lbs.		
Grass, 12 oz. The produce per acre - - - -				130680	0 =	8167	8	0
80 dr. of grass weigh, when dry - -	34	0	-	55539	0 =	3471	3	0
The produce of the space, ditto - -	81	0¾						
The weight lost by the produce of one acre in drying - - - -						4696	5	0
64 dr. of grass afford of nutritive matter -	2	0	-	4083	12 =	2255	3	12
The produce of the space, ditto - -	6	0						

This grass is late, unproductive, and contains but little nutritive matter. Its creeping roots greatly exhaust the soil: in this variety they are smaller than in the other varieties, but equally difficult to extirpate when once in possession of tenacious clays. The next following species, *(Agrostis repens),* is more troublesome as a weed, though less productive. Neither of these plants produce stolones or runners, like the varieties of the *Agrostis stolonifera;* sometimes, indeed, a few slender runners are found, but they seldom strike root at the joints. The creeping roots abundantly supply this defect in the plant for its propagation, as they creep under the surface, and send up at intervals numerous young shoots. This property of the roots is the best character of distinction for the purpose of the Agriculturist, as it may be found at any season, or stage of growth of the plant.

Flowers in the first week of August, and the seed is ripe about the beginning of September.

Agrostis alba.

White Bent.

Agrostis repens. Creeping-rooted Bent, White Bent.

Agrostis nigra. (Withering). Black Couch-grass.

Agrostis alba. (E. Bot. 1189?)

Specific character: Panicle scattered; branches bare at the base; florets few; calyx inner valve smooth; root creeping.

Obs.—Culms upright, not numerous; leaves slender, generally shrivelled; panicle large, widely spreading when in flower; florets thinly scattered; branches of the panicle naked near their union with the main stem. Root strongly creeping. This comes very near to the *Agrostis alba* of the English Botany. The difference between this and the preceding grass is, perhaps, too little to constitute them distinct species; the culms of the former are decumbent; in this grass they are upright, and the root is more powerfully creeping. It is later in coming into flower, and in perfecting its seed.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a clayey loam, is,

	dr.	qr.		oz.		lbs.		
Grass, 9 oz. The produce per acre - - - - -				98010	0 =	6125	10	0
80 dr. of grass weigh, when dry - -	35	0	- -	42879	6 =	2679	15	6
The produce of the space, ditto - -	63	0						
The weight lost by the produce of one acre in drying - - - - - - -						3445	10	10
64 dr. of grass afford of nutritive matter -	3	0	- -	4594	3 =	287	2	0
The produce of the space, ditto - - -	6	3						

Though a later growing grass, it is less productive than the preceding. It is subject to the rust, and a peculiar disease which dries up the extremities of the leaves, and gives it an unsightly appearance. Simple ploughing will be found ineffectual to root out this weed in clayey soils. It will be found ultimately the cheapest and most expeditious mode of extirpating it, to follow the plough, and fork out the roots. Burning, under such circumstances of soil, would doubtless be highly beneficial, but the roots of this Couch-grass penetrate so deep, that a considerable part of them would escape; and the least particle of the root soon produces a plant.

Flowers in the second week of August, and the seed is ripe about the latter end of September.

Agrostis repens.

Creeping-rooted Bent.

Agrostis stolonifera aristata. Awned Creeping Bent.

Var. 2. Corolla awned; awn long, and knee-bent at the top of the blossom, fixed below the middle of the back of the larger valve; branches of the panicle very rough.

Obs.—The first knowledge I had of this variety was from His Grace the Duke of Bedford, who pointed it out on Priesley Moor. I have since found it common on peaty moors. It can scarcely be distinguished from the *Agr. stolonifera latifolia,* without examining it in the hand. The runners or stolones extend to a great length; they are of a brighter reddish colour than those of the *latifolia,* and every part of the plant is rougher. From these few marks of distinction, this variety may have been overlooked, as I find no mention made of it in the botanical works to which I have had access. It is allied to the *Agrostis canina* or awned var. *Agr. vulgaris* of Dr. Smith, but differs in the form of the panicle, which is more acuminated; calyx more acuminate; awn one-third longer, and bent the contrary way, *i. e.* towards the blossom; branches rougher; culms producing stolones.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a bog soil, is,

	dr.	qr.	oz.		lbs.		
Grass, 13 oz. The produce per acre - - - - - -			141570	0 =	8848	0	0
80 dr. of grass weigh, when dry - -	38	0					
The produce of the space, ditto - -	98	$0\frac{4}{5}$	67372	0 =	4210	12	0
The weight lost by the produce of one acre in drying - - - -			4637	4	0		
64 dr. of grass afford of nutritive matter -	80 gr.						
The produce of the space, ditto - -	260		5898	12 =	368	10	0

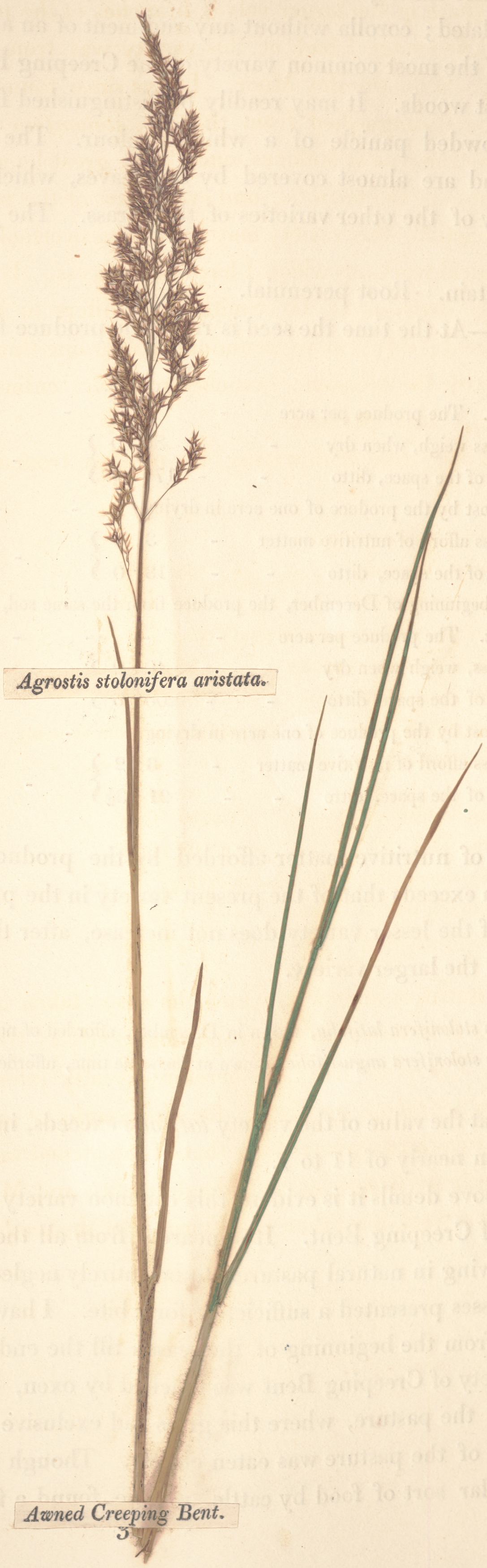
About the beginning of December, the produce from the same soil, is,

	dr.	qr.	oz.		lbs.		
Grass, 15 oz. The produce per acre - - - - - -			163350	0 =	10209	6	0
80 dr. of grass weigh, when dry - -	36	0					
The produce of the space, ditto - -	108	0	73507	8 =	4594	3	8
The weight lost by the produce of one acre in drying - - - -			5615	2	8		
64 dr. of grass afford of nutritive matter -	2	3					
The produce of the space, ditto - -	10	$1\frac{1}{4}$	7018	15 =	438	10	15

The weight of nutritive matter in which the crop, taken in December, exceeds that of the crop when the grass is in flower in the proportion nearly of 10 to 13, is 70lbs.

This variety of Creeping Bent is therefore greatly inferior to the larger-leaved variety, *(Agrostis stolonifera latifolia),* or Fiorin; for the weight of nutritive matter per acre, afforded by the *latifolia,* is two-thirds greater than that of the awned variety. Cattle appear to eat this grass in common with the Rough-stalked Meadow-grass and Meadow Foxtail-grass.

It flowers about a week later than the Fiorin, but the seed is ripe about the same time.



Agrostis stolonifera aristata.

Awned Creeping Bent.

Agrostis stolonifera angustifolia. Smaller-leaved Creeping Bent.

Var. 3.—Panicle densely crowded with florets; florets small; inner valve of the calyx smooth, outer serrulated; corolla without any rudiment of an awn.

Obs.—This is the most common variety of the Creeping Bent on damp tenacious clayey soils, and in moist woods. It may readily be distinguished from the other varieties by its small oblong crowded panicle of a whitish colour. The stolones are closely pressed to the ground, and are almost covered by the leaves, which are more numerous and shorter than in any of the other varieties of this grass. The joints are small, of a slight brown colour.

Native of Britain. Root perennial.

Experiments.—At the time the seed is ripe, the produce from a bog soil, is,

	dr.	qr.		oz.		lbs.	
Grass, 24 oz. The produce per acre - - - - - -				261360	0 =	16335	0
80 dr. of grass weigh, when dry - -	36	0	- - -	117612	0 =	7350	12
The produce of the space, ditto - -	172	$3\frac{4}{5}$					
The weight lost by the produce of one acre in drying - - - - -						8984	4
64 dr. of grass afford of nutritive matter -	3	0	- - -	12251	4 =	765	11
The produce of the space, ditto - -	18	0					
At the beginning of December, the produce from the same soil, was,							
Grass, 25 oz. The produce per acre - - - - -				272250	0 =	17015	0
80 dr. of grass, weigh when dry - -	40	0	- -	136125	0 =	8507	8
The produce of the space, ditto - -	200	0					
The weight lost by the produce of one acre in drying - - - - -						8507	8
64 dr. of grass afford of nutritive matter -	3	2	- -	14888	10 =	930	8
The produce of the space, ditto - -	21	$3\frac{1}{2}$					

The weight of nutritive matter afforded by the produce of one acre of the larger-leaved variety of Fiorin exceeds that of the present variety in the proportion of 4 to 3.

The value of the lesser variety does not increase, after the time the seed is ripe, in the same proportion as in the larger variety.

	lbs.
The *Agrostis stolonifera latifolia*, mown in December, afforded of nutritive matter - -	1435
The *Agrostis stolonifera angustifolia*, mown at the same time, afforded only - -	930

Which shews that the value of the variety *latifolia* exceeds, in December, that of the *angustifolia*, in the proportion nearly of 11 to 7.

From the above details it is evident this common variety stands next in value to the larger-leaved variety of Creeping Bent. It appeared, from all the observations I could make on this grass while growing in natural pastures, to be entirely neglected by cattle while any of the superior pasture grasses presented a sufficiency for a bite. I have examined pastures, in which this grass abounds from the beginning of the season till the end, but never could observe that any part of this variety of Creeping Bent was touched by oxen, horses, or sheep; and the lowest or moister parts of the pasture, where this grass had exclusive possession, were neglected by the cattle; the rest of the pasture was eaten closely. Though the temporary acceptance or rejection of a particular sort of food by cattle, will be found a fallacious criterion of its merit or

Agrostis stolonifera angustifolia.

Smaller-leaved Creeping Bent.

comparative value, nevertheless, in instances like the present, where the plant possesses no superior quality otherwise to recommend it, as nutritive properties, early growth, and productive powers, the dislike of cattle to partake of it, adds greatly to the demerits of the plant.

Flowers in the second and third weeks of July, and ripens the seed about the end of August.

Agrostis palustris. Marsh Bent.

Specific character: Panicle loose when in flower, spike-like when the seed is perfected; Calyx-valves equal, the outer only serrulated, larger valve of the corolla with a minute straight awn fixed above its middle, and reaching to its point, obsolete.

Obs.—It varies much in size, according to the soil in which it grows. In marshes the panicle is very large, exceeding that of the Fiorin, and every other part of the plant in proportion. In poor clayey soils its growth is much smaller, being there inferior to the *Agrostis stolonifera, var. angustifolia.* The panicle is spear-shaped, but tapers to a point; after the time of flowering it contracts very much, and resembles a spike. The colour of the panicle is lighter than in any other variety of stoloniferous, or Creeping-stemmed Bent-grass. This might perhaps be considered only a variety of the *Agrostis stolonifera,* but its properties and structure differ more from those of the varieties of the *A. stolonifera* than what these do from each other. I have retained Dr. Withering's name, *palustris,* as a species.

Experiments.—At the time of flowering, the produce from a bog soil, is,

	dr.	qr.	oz.		lbs.	
Grass, 15 oz. The produce per acre - - - -			163350	6 =	10209	6
80 dr. of grass weigh, when dry - -	36	0				
The produce of the space, ditto - -	108	0	73507	8 =	4534	3
The weight lost by the produce of one acre in drying - - - - -					5615	2
64 dr. of grass afford of nutritive matter -	2	3				
The produce of the space, ditto - -	10	1¼	7018	15 =	438	10
At the time the seed is ripe, the produce is,						
Grass, 20 oz. The produce per acre - - - -			217800	0 =	13612	8
80 dr. of grass weigh when dry - -	32	0				
The produce of the space, ditto - -	128	0	87120	0 =	5445	0
The weight lost by the produce of one acre in drying - - - -					8167	8
64 dr. of grass afford of nutritive matter -	2	3				
The produce of the space, ditto - - -	13	3	9358	9 =	584	14
The weight of nutritive matter, in which the crop at the time the seed is ripe, exceeds that at the time of flowering, is - - - - - - - -					146	3

The proportional value of the grass of each crop is equal.

This grass is properly a subaquatic. It will grow on tenacious clays, but it seems only to thrive in very moist soils, or in such as are for the most part covered with water. In moist woods it is more frequent than any other of the Creeping-stemmed Bent grasses; here the culmns often attain to five feet in height, when supported by bushes.

The above details shew the inferior nature of this grass, compared to the larger, and even to the lesser-leaved varieties of the *Agrostis Stolonifera.* It cannot, therefore, as yet be considered in any other light than a weed that chokes up drains and underwood.

Flowers about the second week of July, and the seed is ripe about the middle and towards the end of August.

Agrostis palustris.

Marsh Bent.

Poa fluitans. E. Bot.; Flo. Ger. Flote Meadow-grass.

Festuca fluitans. Host.; Curtis; Flo. Dan. Flote Fescue.

Specific character: Panicle branches, some pressed to the main stalk, others diverging from it; spikets pressed to the stalk, roundish, many-flowered; florets obtuse, with seven nerves. Root creeping. Host. t. 77, *F. fluitans;* E. Bot, 1520, *Poa fluitans.*

Obs.—This grass has sometimes been mistaken for the *Agrostis stolonifera* (Fiorin). When in flower there is no difficulty in distinguishing them, the number of florets in each calyx being from five to eleven; in Fiorin only one. The leaves are much broader, flat, and perfectly smooth. By simply drawing the finger down the leaves of the Fiorin, they will be found sensibly rough to the feel, but those of the Flote Meadow-grass perfectly smooth; by which means the two grasses may be distinguished at any stage of growth. The nectary is in the form of a small heart-shaped gland, placed at the base of the germ.

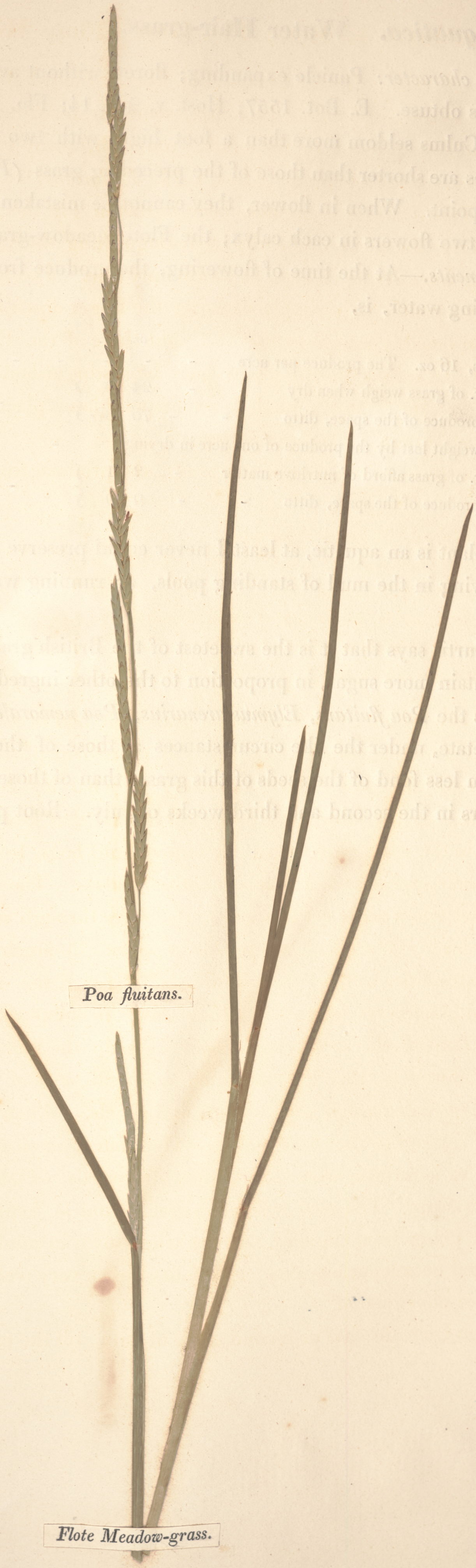
Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a strong tenacious clay, is,

	dr.	qr.		oz.		lbs.	
Grass, 20 oz. The produce per acre - - - -				217800	0 =	13612	8
80 dr. of grass weigh, when dry - -	24	0	- -	65340	0 =	4083	12
The produce of the space, ditto - -	96	0					
The weight lost by the produce of one acre in drying - - - - -						9528	12
64 dr. of grass afford of nutritive matter -	1	3	- -	5955	7 =	372	3
The produce of the space, ditto - -	8	3					

The above produce was taken from grass that had occupied the ground four years, during which time it had increased every year; it therefore appears capable of being cultivated as a permanent pasture grass, which is contrary to what has been supposed of the Flote Fescue. Some writers on the subject of grasses inform us, that kine and hogs are fond of this grass; and that cows in the spring are frequently enticed into bogs, by endeavouring to get at the young shoots, which appear earlier than most other grasses. The result of my observations lead me to believe, that when cattle eat this grass, it is more through wantonness, than any particular relish they have for it. On a bog, where this grass was in much abundance, black cattle only cropped the extremities of the leaves, while the foliage of the *Agrostis stolonifera aristata, Poa trivialis,* and *Alopecurus pratensis,* which grew in company with it, were closely eaten down. Birds are fond of the seeds, and generally strip the panicle ere the seeds are all perfected. Schreber informs us, that it is cultivated in several parts of Germany for the sake of the seeds, which are esteemed a delicacy in soups and gruels. When ground into meal, they make bread very little inferior to that from wheat. The bran is given to horses that have the worms, but they must be kept from water some hours afterwards. Fish, particularly trout, are said to be fond of the seeds. The seed will not vegetate unless kept very moist, indeed I never could obtain any plants from the seed, except when sown in mud; when raised in this manner, and transplanted on a tenacious clay, the plants throve very well, and on the fourth year afforded the produce above stated.

Flowers from the first or second week of July, till the end of summer.


Poa fluitans.
Flote Meadow-grass.

Aira aquatica. Water Hair-grass.

Specific character: Panicle expanding; florets without awns, smooth, longer than the calyx; husks obtuse. E. Bot. 1557; Host. v. 2, t. 14; Flo. Dan. t. 381, bad figure.

Obs.—Culms seldom more than a foot high, with two or three joints, never more. The leaves are shorter than those of the preceding grass *(Poa fluitans)*, and more rounded at the point. When in flower, they cannot be mistaken for each other: the Hair-grass has only two flowers in each calyx; the Flote Meadow-grass, from 5 to 11.

Experiments.—At the time of flowering, the produce from mud, covered permanently with running water, is,

	dr.	qr.		oz.		lbs.		
Grass, 16 oz. The produce per acre - - - - - -				174240	0 =	10890	0	0
80 dr. of grass weigh when dry - -	24	0	- -	52272	0 =	3267	0	0
The produce of the space, ditto - -	76	$3\frac{1}{10}$						
The weight lost by the produce of one acre in drying - - - -				7623	0	0		
64 dr. of grass afford of nutritive matter -	2	1	- -	6125	10 =	382	13	10
The produce of the space, ditto - -	9	0						

This plant is an aquatic, at least I never could preserve it out of water. It is found naturally growing in the mud of standing pools, or running waters. It is therefore unfit for cultivation.

Mr. Curtis says that it is the sweetest of the British grasses; but there are several species which contain more sugar, in proportion to the other ingredients which compose their nutritive matter, as the *Poa fluitans, Elymus arenarius, Poa nemoralis angustifolia, Poa aquatica.* The seeds vegetate, under the like circumstances as those of the *Poa fluitans,* already mentioned. Birds seem less fond of the seeds of this grass, than of those of the Flote Meadow-grass.

Flowers in the second and third weeks of July. Root perennial and creeping.

Aira aquatica.

Water Hair-grass.

Aira cæspitosa. Turfy Hair-grass, Hassock-grass.

Specific character: Panicle diffuse; husks of the corolla woolly, and awned at the base; awn straight, short; leaves flat.

Obs.—Root fibrous. Panicle large, of a fine purple silky appearance. Root leaves forming dense tufts, extremely rough; the edges so sharp, as to cut the finger when passed between them. Culms from a foot and a half to three feet high. Two, seldom or never three flowers in each calyx; hairy at the base, the lowermost one sitting. E. Bot. 1453; Hos. 2, t. 43; Flo. Dan. t. 157; Moris. s. 8, t. 7, fig. upper.

Experiments.—At the time the seed is ripe, the produce from a strong tenacious clay, is,

	dr.	qr.	oz.		lbs.		
Grass, 15 oz. The produce per acre - - - - - - -			163350	0 =	10209	0	0
80 dr. of grass weigh, when dry - -	26	0	- - 53088	12 =	3318	0	0
The produce of the space, ditto - -	135	$0\frac{1}{5}$					
The weight lost by the produce of one acre in drying - - - - - - -			6891	5	0		
64 dr. of grass afford of nutritive matter -	2	0	- - 5104	11 =	319	0	11
The produce of the space, ditto - - -	7	2					

The above details prove the innutritious nature of this grass; but even if it had greater nutritive powers, the extreme coarseness of the foliage would render it unfit for cultivation. Cattle sometimes crop the ends of the young leaves, but in all the instances that have come under my observation, it appeared to be from supreme necessity. The only point to be considered here, therefore, is how to overcome, or destroy it on soils where it has got possession. It delights in moist clayey soils, where the water stagnates; but is found in almost every kind of soil, from the dry sandy heath to the bog. It forms dense tufts in pastures, very disagreeable to the sight, and are termed hassocks, bulls' faces, &c. by Farmers. It is a most difficult plant to extirpate when in considerable quantity. Some persons, to get rid of it, dig up the tufts, and fill up the holes with lime compost; this, no doubt, would answer the end, at least for a few years, if all the roots were destroyed; but this is never the case; a circle of roots is left, which in one or two seasons produce larger hassocks than before; and besides, when the hassocks are numerous, the expence attending this process is considerable. Others depend on occasional mowings to keep the hassocks under. But this is productive of little good, particularly if the mowing of the tufts be deferred till the autumn, which, I believe, is the common practice. I have found no treatment weaken or retard the growth of grass so much, as cutting it closely before and soon after the first tender shoots appear in the spring. On the contrary, when left uncut till the flowers are formed, or the seed becomes ripe, mowing then encourages the growth of the plant, and a great increase and activity of the roots ensue. In this palliative remedy, therefore, the principal efforts should be made to keep the plant close to the roots in the early part of the spring, and till Midsummer.

But the only effectual and most profitable mode of extirpating this grass, is by first paring and burning the surface of the land, and by making proper drains, to correct, as much as possible, the tenacious nature of the soil: in this case, surface-drains are as necessary as those termed hollow. Sand should likewise be applied during the course of crops taken previous to returning the land again to permanent pasture, if such should be desirable from its local situation, as that for instance of a park or policy.

Flowers about the third week of July, and the seed is ripe towards the end of August.

Aira cæspitosa.

Turfy Hair-grass.

Alopecurus geniculatus. Knee-jointed Foxtail-grass.

Specific character: Culms ascending; panicle spike-like, cylindrical, obtuse; husks of the calyx united at the base, obtuse, somewhat woolly; apex of the corolla minutely notched.

Obs.—There are two varieties of this species of Foxtail-grass; the present, which is by far the most common, is distinguished from the other by its fibrous root and greater size; the less common variety has a bulbous root. The *Alopecurus Bulbosus* may be distinguished from the bulbous-rooted variety of the knee-jointed species, by its upright culms, which want the knee-jointed form so conspicuous in the culms of the former. The anthers are at first of a purple colour, but afterwards become ferruginous. E. Bot. 1250; Wither. ii. p. 120; Flo. Rust. t. 97; Host. t. 32; Curt. Lond. t. 57.

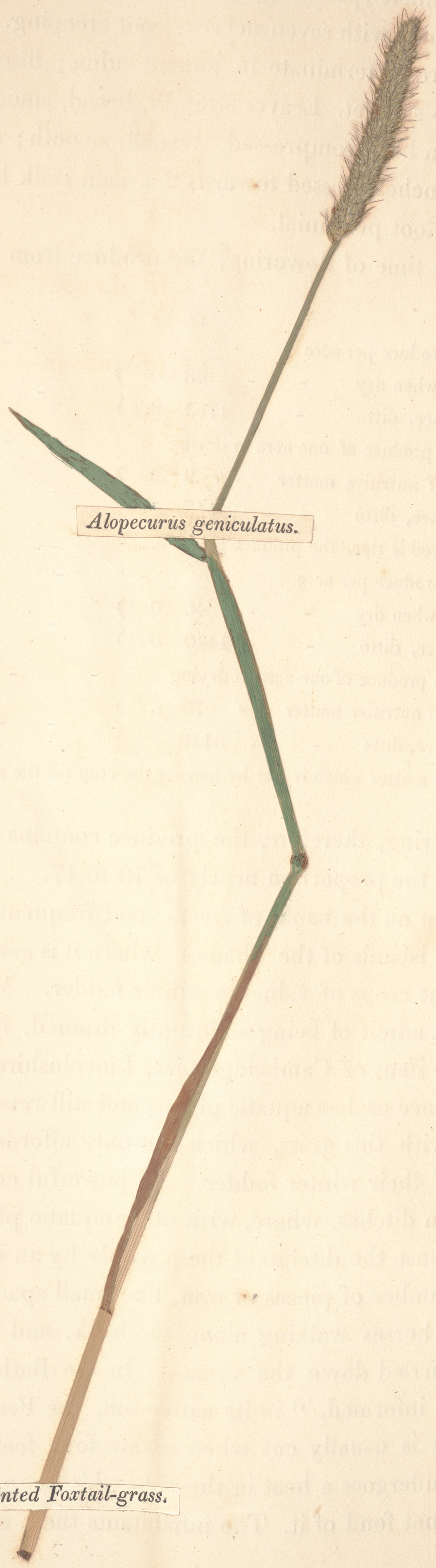
Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a rich moist alluvial soil, is,

	dr.	qr.	oz.		lbs.	
Grass, 10 oz. The produce per acre - - - - - -			108900	0 =	6806	4
80 dr. of grass weigh when dry - -	34	0	- - 46282	8 =	2892	10
The produce of the space, ditto - -	68	0				
The weight lost by the produce of one acre in drying - - - -					3913	10
64 dr. of grass afford of nutritive matter -	2	3	- - 4679	4 =	292	7
The produce of the space, ditto - -	6	3½				

This produce may be considered the greatest that this grass is capable of affording under ordinary circumstances; for the produce from clayey, sandy, and peaty soils was, in each instance, inferior to the above. In an open drain, in a rich water-meadow, where this grass appeared to have attained the highest degree of luxuriance, some of the shoots measuring two feet and a half in length, the weight of produce was but 14 oz.; on drier ground in the same meadow, it weighed only 5 oz. It grows common in surface-drains, and at the entrance of cattle-ponds, particularly where the soil is clayey. It does not appear to be eaten with much relish by either cows, horses, or sheep. Its nutritive powers are not considerable, and its subaquatic natural place of growth, excludes any recommendation of it for cultivation.

Flowers in the first week of June, and during the summer.



Alopecurus geniculatus.

Knee-jointed Foxtail-grass.

Poa aquatica. Water-meadow Grass.

Specific character: Panicle spreading equally, much branched; spikets linear, 5-9 flowered; florets obtuse, distant, with seven nerves; root creeping.

Obs.—The creeping roots terminate in jointed culms; fibrous roots numerous. Culms very high, from three to six feet. Leaves straight, broad, smooth on every part except the edges and keel; sheaths a little compressed, striated, smooth; scales short, obtuse. Panicle very large, upright, branches pressed towards the main stalk before and after flowering.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a strong tenacious clay, is,

	dr.	qr.		oz.		lbs.		
Grass, 186 oz. The produce per acre - - - -				2025540	0 =	126596	4	0
80 dr. of grass weigh, when dry - -	48	0	- -	1215324	0 =	75957	12	0
The produce of the space, ditto -	1785	$2\frac{2}{10}$						
The weight lost by the produce of one acre in drying - - - - - -				50638		8	0	
64 dr of grass afford of nutritive matter -	2	2	- -	79122	0 =	4945	2	0
The produce of the space, ditto - -	116	1						
At the time the seed is ripe, the produce is,								
Grass, 180 oz. The produce per acre - - -				1960200	0 =	122512	8	0
80 dr. of grass weigh, when dry - -	40	0	- -	980100	0 =	61256	4	0
The produce of the space, ditto - -	1440	0						
The weight lost by the produce of one acre in drying - - - -				61256		4	0	
64 dr. of grass afford of nutritive matter -	70 gr.		- -	71465	10 =	4466	9	0
The produce of the space, ditto - -	3150							
The weight of nutritive matter which is lost by leaving the crop till the seed be ripe, is -				478		9	0	

At the time of flowering, therefore, the produce contains more nutritive matter than at the time the seed is ripe, in the proportion nearly of 19 to 17.

This grass is common on the banks of rivers, and frequent on the margin of standing pools. On the banks and little islands of the Thames, where it is generally mown twice in the year for hay, it affords abundant crops of valuable winter fodder. Mr. Curtis informs us, that in flat countries, which do not admit of being sufficiently drained, it is almost the only grass for hay and pasturage. In the Fens of Cambridgeshire, Lincolnshire, &c. immense tracts that used to be overflowed and produce useless aquatic plants, and still retain much moisture, though drained by mills, are covered with this grass, which not only affords rich pasturage in summer, but forms the chief part of their winter fodder. Its powerful creeping roots make it a dangerous and troublesome plant in ditches, where, with other aquatic plants, it soon chokes them up. In the Isle of Ely they cleanse the ditches of these weeds by an instrument called a *bear*, which is an iron roller, with a number of pieces of iron, like small spades, fixed in it. This is drawn up and down the river by horses walking along the bank, and tears up the plants by the roots, which float, and are carried down the stream. In the Bath Agricultural Papers, the Water-meadow Grass, we are informed, " in its native soil, the Fens of the Isle of Ely, grows to the height of six feet. It is usually cut when about four feet high; when dry they bind it in sheaves; it generally undergoes a heat in the rick, which improves it. It is excellent fodder for milch-cows; horses are not fond of it. The inhabitants there call it fodder, by way of eminence,

Poa aquatica.

Water Meadow-grass.

other kinds of coarse hay being called stover, *i. e.* coarse stuff. It is also called white lead, drying of a white colour."

The nutritive matter of this grass contains a greater proportion of sugar than exists in any of the superior pasture grasses. I offered a bundle of the grass to a horse that was grazing on a field of White Clover; the animal ate it with seeming relish, taking a bite of the Clover, and then another of the *Poa aquatica*, alternately, till the whole of it was consumed. It does not grow freely from seed, except when sown in mud. The best manner of propagating it, according to my experience, is by planting the roots, which from their creeping nature, soon increase the number of plants. The best season for sowing the seeds is in the autumn, as soon as they are ripe. The roots may be planted in the autumn, or spring, with equal success. The Rev. Bartholomew Dacre of Moseley, has made several experiments on this grass; and the results prove, that it may be cultivated on more elevated situations than has been supposed, and that propagating it by planting the roots, is the best mode.

Flowers about the second and third weeks of July, and the seed is ripe about the second week of August.

Eriophorum angustifolium. Long-leaved Cotton-grass.

Specific character: Culms almost three-cornered; leaves channelled, three-sided; fruit-stalks smooth. E. Bot. 564; Flo. Germ.

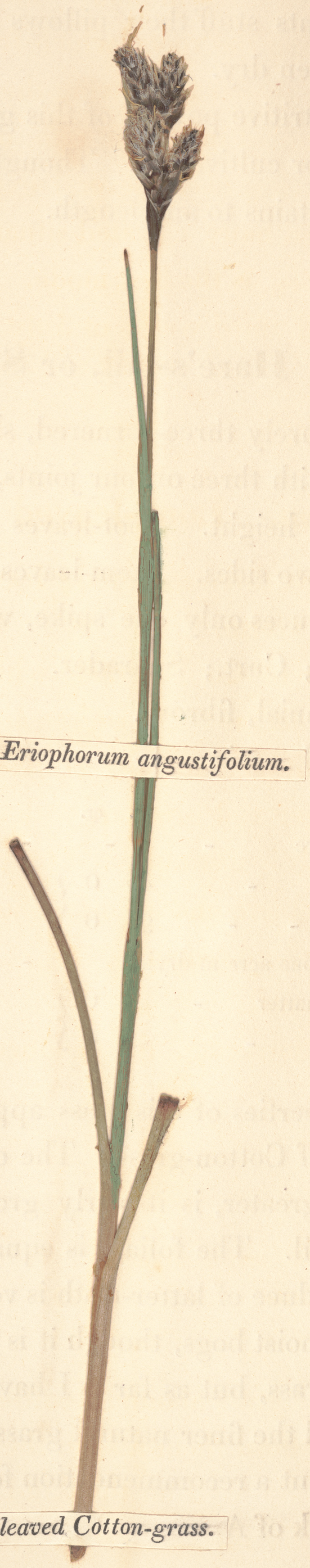
Obs.—There are three species of Cotton-grass, which greatly resemble each other: the *E. triquetrum*, *E. angustifolium*, and *E. polystachion*. The *E. angustifolium*, (the species now under consideration), differs from the *Triquetrum* in having a thicker and more succulent culm; the leaves longer and broader, with only one nerve of a reddish colour, and the fruit-stalks are smooth. It is distinguished from the *Polystachion* by its creeping roots; leaves twice the length; involucre and sheaths smooth, spikets smaller; fruit-stalks shorter, and the woolly hairs every where longer.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a bog soil, is,

	dr.	qr.		oz.		lbs.		
Grass, 12 oz. The produce per acre -	-	-	-	130680	0 =	8167	8	0
80 dr. of grass weigh, when dry -	40	0						
The produce of the space, ditto - -	96	0	-	-	65340	0 =	4083	12	0
The weight lost by the produce of one acre in drying			-	-	-	-	4083	12	0
64 dr. of grass afford of nutritive matter -	2	2						
The produce of the space, ditto - -	7	2	-	-	5104	11 =	319	0	0

On bogs and moors where this grass abounds, cattle crop the leaves in the spring; but as soon as the finer kinds of grasses afford them a bite, they neglect it. There are many grasses of superior value, that succeed equally well on this kind of soil. When such lands are capable of being drained (which is generally the case), it should be effected, and the soil will then carry the superior grasses, as the Meadow Fescue, Cock's-foot Grass, Meadow Cat's-tail Grass, Meadow Fox-tail Grass, Rough-stalked Meadow-grass, &c. Where draining cannot be economically practised, the surface should be pared and burnt, and afterwards planted with Fiorin,



Eriophorum angustifolium.

Long-leaved Cotton-grass.

(Agrostis stolonifera, var. *latifolia);* or with the water meadow-grass, *(Poa aquatica).* If the soil be not too wet for the former, or too peaty for the latter, the produce will be found amply to reward the labour of preparing and planting the soil. Mr. Pennant says, that about April, in the Isle of Skye, the Farmers turn their cattle during the day time to this grass, which springs first, and at night drive them into dry ground again.

In Germany, Professor Martyn informs us, and in the more northern parts of Europe, the down has been manufactured into various articles of dress, paper, and wicks for candles. In some parts of Sweden, the peasants stuff their pillows with it, whence it is called poor man's pillow; but it becomes brittle when dry.

Neither the productive or nutritive powers of this grass appear, from the above details, sufficiently great to recommend it for cultivation. Though it comes into flower in June, it is late in the spring before the foliage attains to any length.

Eriophorum vaginatum. Hare's-tail, or Sheathed Cotton-grass.

Specific character: Culms obscurely three-cornered, sheathed; spike oval-oblong.

Obs.—Culms erect, smooth, with three or four joints, roundish below, three-cornered above, from six to twelve inches in height. Root-leaves sharp-pointed, streaked on two sides, convex on one side, flat on two sides. Stem-leaves less sharp, upper one with a remarkable inflated sheath. It produces only one spike, which is upright. E. Bot. 873; Host. i. t. 39. *E. cæspitosum;* Linn.; Curt.; Schrader.

Native of Britain. Root perennial, fibrous.

Experiments.—At the time of flowering, the produce from a bog soil, is,

	dr.	qr.		oz.		lbs.		
Grass, 10 oz. The produce per acre -	-	-	-	108900	0 =	6806	4	0
80 dr. of grass weigh, when dry -	46	0	-	-	62620	0 =	3913	9	0
The produce of the space, ditto - -	92	0						
The weight lost by the produce of one acre in drying			-	-	-	-	2892	11	0
64 dr. of grass afford of nutritive matter -	2	0	-	-	3403	2 =	212	11	0
The produce of the space, ditto -	5	0						

The produce and nutritive properties of this grass appear, from the above details, to be very inferior to the preceding species of Cotton-grass. The chief property that would give value to it, if its productive powers were greater, is its early growth, being one of the earliest of the British grasses; flowering in April. The foliage is equally early, growing in proportion with the flowering culms; but its produce of latter-math is very inconsiderable. It is more frequent on moors of a drier nature, than moist bogs, though it is to be met with on most of them. Sheep are said to be very fond of this grass, but as far as I have had opportunity to observe, they only crop the foliage in the spring, till the finer natural grasses afford them a bite. It offers, therefore, no particular merit to warrant a recommendation for the purposes of the Agriculturist.

It flowers about the third week of April, and the seed is ripe about the third week of May.

Eriophorum vaginatum.

Hare's-tail Cotton-grass.

Arundo colorata. Hort. Kew. i. p. 174. Striped Reed Canary-grass.

Phalaris arundinacea. E. Bot. t. 402; Host. 2, t. 33. Reed Canary-grass.

Calamagrostis variegata. Wither. Arr. ii. p. 124. Ladies'-traces, Painted Lady-grass, Gardener's-garters.

Specific character: Calyx one-flowered, keeled, corollas smooth, with two lanuginose pencils at the base, leaves flat.

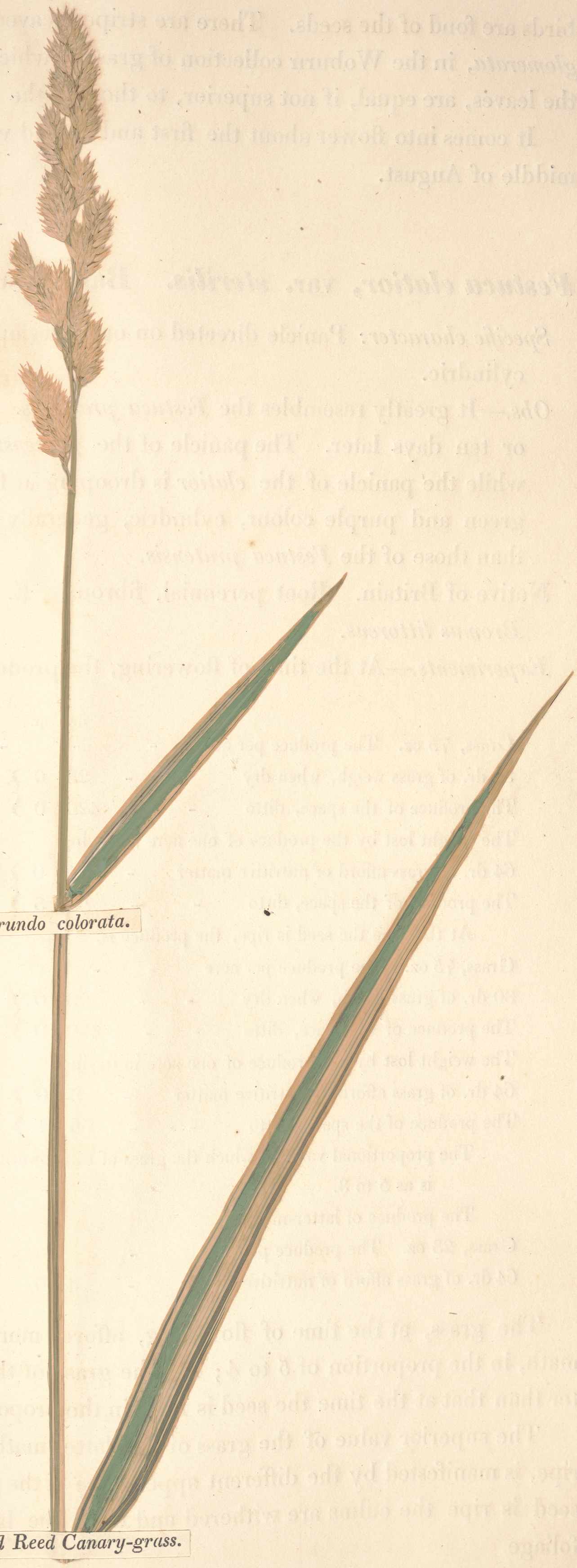
Obs.—Root creeping, jointed; culms from two to six feet in height; valves of the calyx with two ribs on each side, not much larger than the corolla, hairy at the edges, and furnished with a small, slender, hairy appendage on each side; the outer valve not rolled in; nectaries two, lanceolate-acuminate, with one tooth on the outer edge; seed oval, flatted, and shining. This grass partakes of some of the characters of *Phalaris* as well as of *Arundo.*

Native of Britain. Perennial.

Experiments.—At the time of flowering, the produce from a black sandy loam incumbent on clay, is,

	dr.	qr.		oz.		lbs.		
Grass, 40 oz. The produce per acre - - - -				435600	0 =	27225	0	0
80 dr. of grass weigh, when dry - -	36	0	- -	196020	0 =	12251	4	0
The produce of the space, ditto - -	288	0						
The weight lost by the produce of one acre in drying - - - - -				4973	12	0		
64 dr. of grass afford of nutritive matter -	4	0	- -	27225	0 =	1701	9	0
The produce of the space, ditto - -	40	0						
From a strong tenacious clay, the produce is,								
Grass, 50 oz. The produce per acre - - - - - -				544500	0 =	34031	0	0
80 dr. of grass weigh, when dry -	40	0	- -	272250	0 =	17015	8	0
The produce of the space, ditto - -	400	0						
The weight lost by the produce of one acre in drying - - - -				17015	8	0		
64 dr. of grass afford of nutritive matter -	4	0	- -	34031	4 =	2126	15	0
The produce of the space, ditto - -	50	0						

From these details of experiments it appears, that the Striped Reed Canary-grass is much more productive on a tenacious clayey soil than on a rich sandy loam. The superior nutritive powers which this grass possesses, recommends it to the notice of occupiers of tenacious clayey soils. The foliage cannot be considered coarse, when compared to other grasses which afford a produce equal in quantity. Dry straw is a much coarser food than the hay made from this grass. The *Festuca elatior* grows as luxuriantly, and affects a similar soil, though of a nature less retentive. It being greatly superior to the *Arundo colorata* in early growth, nutritive qualities, and in the produce of latter-math, should be preferred before it, to cultivate on tenacious clays that are less fitted for the production of superior grasses. The objection, as to the coarse nature of the produce of these grasses, might be obviated by reducing the hay to chaff. Their nutritive powers are equal to those of the superior grasses, and their produce in quantity superior. The Striped Reed Canary-grass has not yet been found in a wild state. It is cultivated in gardens, for the beauty of its striped leaves. The common wild variety, which grows by the sides of rivers and standing pools, wants this distinguishing feature. It grows to a greater height than the striped-leaved variety, and does not appear to be eaten by cattle; but



Arundo colorata.

Striped Reed Canary-grass.

birds are fond of the seeds. There are striped-leaved varieties of the *Agrostis alba*, and *Dactylis glomerata*, in the Woburn collection of grasses, which for the strength and beauty of the tints in the leaves, are equal, if not superior, to those of the Striped-leaved Reed-grass.

It comes into flower about the first and second weeks of July, and the seed ripens about the middle of August.

Festuca elatior, var. *sterilis*. Barren-seeded Tall Fescue.

Specific character: Panicle directed on one side, upright; spikets mostly awned, the outer one cylindric.

Obs.—It greatly resembles the *Festuca pratensis*. It is larger in every respect; flowers eight or ten days later. The panicle of the *pratensis* is upright at first, afterwards drooping, while the panicle of the *elatior* is drooping at first, and afterwards upright; spikets of a green and purple colour, cylindric, generally awned; leaves rougher, and less pointed than those of the *Festuca pratensis*.

Native of Britain. Root perennial, fibrous. E. Bot. 1593; Curt. Lond. 6. t. 7; Flo. Ger. *Bromus littoreus*.

Experiments.—At the time of flowering, the produce from a black rich loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 75 oz. The produce per acre - - - - - -			816750	0 =	51046	14	0
80 dr. of grass weigh, when dry - -	28	0					
The produce of the space, ditto - -	420	0	285862	8 =	17866	6	8
The weight lost by the produce of one acre in drying - - - -			33180	7	8		
64 dr. of grass afford of nutritive matter -	5	0					
The produce of the space, ditto - -	93	3	63808	9 =	3988	0	9

At the time the seed is ripe, the produce is,

Grass, 75 oz. The produce per acre - - - - - -			816750	0 =	51046	4	0
80 dr. of grass weigh, when dry . - -	28	0					
The produce of the space, ditto - -	420	0	285862	8 =	17866	6	8
The weight lost by the produce of one acre in drying - - - -			33179	13	8		
64 dr. of grass afford of nutritive matter -	3	0					
The produce of the space, ditto - -	56	1	38285	2 =	2392	13	2

The proportional value in which the grass of the flowering crop exceeds that at the time the seed is ripe, is as 5 to 3.

The produce of latter-math is,

Grass, 23 oz. The produce per acre - - - -			250470	0 =	15654	6	0
64 dr. of grass afford of nutritive matter -	4	0	15654	6 =	978	6	6

The grass, at the time of flowering, affords more nutritive matter than that of the latter-math, in the proportion of 5 to 4; but the grass of the latter-math contains more nutritive matter than that at the time the seed is ripe, in the proportion of 4 to 3.

The superior value of the grass of the latter-math, compared to that at the time the seed is ripe, is manifested by the different appearance of the grass at these stages of growth. When the seed is ripe the culms are withered and dry; the latter-math consists of fine green succulent foliage.

Festuca elatior fertilis.

Fertile Tall Fescue.

The produce from a tenacious clay, is,

	dr.	qr.	oz.		lbs.	
Grass, 70 oz. The produce per acre - - - - -			762300	0 =	47643	12 0
64 dr. of grass afford of nutritive matter -	5	0 - - -	59554	11 =	3722	2 0

A tenacious clay is, therefore, best fitted for the production of this grass; as, notwithstanding the plentiful supply of manure, the produce from the loam which had the advantages of it, scarcely exceeds that from the clay. I know of no grass of this class adapted for clays, that holds out such fair promises to repay the Farmer. It is one of the earliest grasses, with regard to the production of foliage early in the spring. It is nutritive, and very productive. It is true, the produce may be denominated coarse, when compared to the *Festuca pratensis*, *Alopecurus pratensis*, and other of the superior grasses; but where is a grass to be found that produces a great weight of crop, that is not in some degree coarse? This objection, however, as before observed, may be overcome by reducing the hay to chaff, and mixing it with Clover-hay. The nutritive matter contains but little bitter extractive or saline matter, whereas the Clover contains an excess. It does not perfect much good seed, and can only therefore be propagated by parting and planting the roots.

The next following specimen, is of a grass which I believe to be a variety of *Festuca elatior*. It ripens an abundance of seed, and appears in most respects equal to that variety in agricultural merits.

The present variety flowers in the second week of July; the seed is universally, according to all my observations, affected with the disease termed *clavus*, and consequently unfertile.

Festuca elatior, var. *fertilis*. Fertile-seeded Tall Fescue.

Obs.—Differs from the common variety of Tall Fescue, in having the panicle somewhat drooping; spikets six-flowered, more ovate and flat; the larger husk of the calyx often awned, and the awn is fixed on the apex more in the manner of that of a Bromus than a Fescue. Leaves smoother, and of a less dark green colour.

Experiments.—At the time of flowering, the produce from a black sandy loam incumbent on clay, is,

	dr.	qr.	oz.		lbs.	
Grass, 80 oz. The produce per acre - - - -			871200	0 =	54450	0
80 dr. of grass weigh, when dry - -	35	0				
The produce of the space, ditto - -	560	0	381150	0 =	23821	14
The weight lost by the produce of one acre in drying - - - - -					30628	2
64 dr. of grass afford of nutritive matter -	5	0				
The produce of the space, ditto - -	100	0	68062	8 =	4253	14

This grass, which is nearly allied to the common *Festuca elatior*, perfects an abundance of seed, though not entirely free from diseased portions, and is therefore not liable to the objection which takes so much from the value of that variety. It is equally early in the produce of foliage, and flowers earlier than the barren Tall Fescue by eight or ten days; the produce is equally nutritive. For damp soils that cannot conveniently be made sufficiently dry by drains, this would

Festuca elatior sterilis.

3

Barren-seeded Tall Fescue.

be a most valuable plant, either to be cut for soiling, or made into hay, and reduced to chaff as it might be wanted. I have never seen this plant in a wild state; it was first discovered here in the grass garden, seemingly introduced by accident. W. P. Taunton, Esq. of London, was kind enough to send me some seeds of a grass which he found growing on a bastard fuller's-earth soil in considerable plenty, in the parish of Kilmersdon, Somerset. I believe this to be the same grass.

Mr. Taunton, who has paid much attention to the subject, conceives that the disease termed *clavus*, which renders the seed of the other variety of Tall Fescue abortive, may be caused by over-richness of the soil. My observations tend to confirm that opinion in a considerable degree, that at least if it is not the sole cause, over-richness, and great humidity of the soil and atmosphere, greatly encourage the disease, as it often occurs, partially, to many other grasses under such circumstances only.

It comes into flower about the beginning of July, and the seed is ripe about the first week in August.

Bromus littoreus. Sea-side Brome-grass.

Specific character: Panicle branches wide-spreading; spikets oval-spear shaped, sometimes awned, from 4 to 5-flowered.

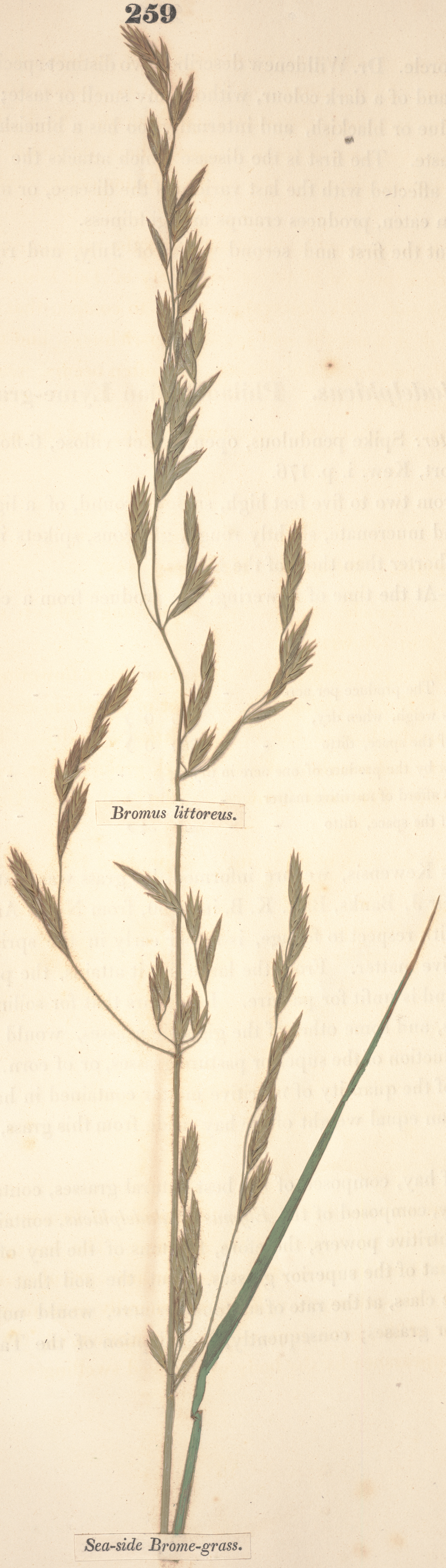
Obs.—The panicle is perfectly upright before and after flowering, which distinguishes it from the varieties of *Festuca elatior;* the number of florets in each calyx is less, the spikets are oval-spear shaped, those of the *Festuca elatior* cylindric. The leaves are broader, more deeply striated, and rougher, of a finer dark green colour, particularly in the spring.

Native of Germany. Perennial; growing on the banks of the Danube and other rivers. Host. Gram. p. 7, t. 8.

Experiments.—At the time of flowering, the produce from a clayey loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 61 oz. The produce per acre - - - - -			664290	0 =	41518	2	0
80 dr. of grass weigh, when dry - -	41	0					
The produce of the space, ditto - -	500	$0\frac{2}{10}$	340448	10 =	21278	0	10
The weight lost by the produce of one acre in drying - - - -			20240		1	6	
64 dr. of grass afford of nutritive matter -	1	2					
The produce of the space, ditto - -	22	$3\frac{1}{2}$	15569	0 =	973	1	0
At the time the seed is ripe the produce is,							
Grass, 56 oz. The produce per acre - - - - -			609840	0 =	38115	0	0
80 dr. of grass, weigh when dry - -	32	0					
The produce of the space, ditto - -	49	0	33350	9 =	2084	6	9

When compared with the Tall Fescue, this species of Brome is found to be inferior in nutritive properties, and in the quality of the herbage. The leaves are much coarser in every respect. It cannot therefore be recommended for any agricultural purpose. The clavus often attacks the seed of this species, though not so generally as to prevent it from perfecting a sufficiency, if the value of the grass required its propagation on the farm. The disease termed clavus, makes its appearance by the body of the seed swelling to three times its usual size, and



Bromus littoreus.

Sea-side Brome-grass.

the want of the corcle. Dr. Willdenew describes two distinct species of it: first, the simple clavus, which is mealy, and of a dark colour, without any smell or taste; second, the malignant clavus, which is violet blue or blackish, and internally too has a blueish colour, a fœtid smell, and a sharp pungent taste. The first is the disease which attacks the grass now spoken of. Bread made from grain affected with the last variety of the disease, or malignant clavus, is of a blueish colour, and when eaten, produces cramps and giddiness.

Flowers about the first and second weeks of July, and ripens the seed in three weeks afterwards.

Elymus Philadelphicus. Philadelphian Lyme-grass.

Specific character: Spike pendulous, open, spikets villose, 6-flowered, the lower ones ternate. (Linn.); Hort. Kew. i. p. 176.

Obs.—Culm from two to five feet high, smooth, round, of a light green or glaucous colour. Leaves broad mucronate, slightly rough, glaucous, spikets in pairs; awns of the calyx or involucre, shorter than those of the florets.

Experiments.—At the time of flowering, the produce from a clayey loam and retentive subsoil, is,

	dr.	qr.		oz.		lbs.		
Grass, 45 oz. The produce per acre - - - -				490050	0 =	30628	2	0
80 dr. of grass weigh, when dry, -	40	0						
The produce of the space, ditto - -	360	0	-	245025	0 =	15314	1	0
The weight lost by the produce of one acre in drying - - - - -						15314	1	0
64 dr. of grass afford of nutritive matter -	4	1						
The produce of the space, ditto - -	47	3¼	- -	32542	6 =	2033	14	6

In the Hortus Kewensis, we are informed this grass was first introduced into England by the Right Hon. Sir J. Banks, Bart. K. B. in 1790, from North America. It is a very productive grass, and with respect to foliage, is rather early in the spring: it contains a considerable quantity of nutritive matter. From the large size it attains, the produce is rank, and proportionally coarse, and is unfit for pasture. It appears that for soiling, or hay to be used in the form of chaff, this, and some other of the gigantic grasses, would be profitable plants on soils unfit for the production of the superior pasture grasses, or of corn,

A comparison of the quantity of nutritive matter contained in hay of the best quality, with that contained in an equal weight of the hay made from this grass, will shew, nearly, their comparative value.

One pound of hay, composed of the best natural grasses, contains of nutritive matter 57 dr. One pound of hay, composed of the *Elymus Philadelphicus*, contains of nutritive matter 34 dr. With regard to nutritive powers, therefore, five tons of the hay of this grass, are scarcely equal to three tons of that of the superior grasses. But the soil that will produce this grass, and others of the same class, at the rate of six tons per acre, would not produce one-fifth the quantity of the superior grasses; consequently, the adoption of the Tall Fescue, and Philadelphian

Elymus Philadelphicus.
Philadelphian Lyme-grass.
3 x

Lyme grasses, on soils of this description, for the uses now described, might be found a profitable measure.

Flowers in the first and second weeks of July, and successively till the end of summer. Seed ripe in about three weeks after the time of flowering.

Elymus striatus. Striated Lyme-grass.

Specific character: Spike erect; spikets 2-flowered, fringed; involucre or calyx striated, short. Hort. Kew. i. p. 177.

Obs.—Native of North America. Root perennial; was introduced into this country about 1790. Ibid.

Experiments.—At the time of flowering, the produce from a clayey loam, is,

	dr.	qr.		oz.		lbs.	
Grass, 30 oz. The produce per acre - - - -				326700	0 =	20418	12
80 dr. of grass weigh, when dry - -	35	0	- -	142937	0 =	8933	9
The produce of the space, ditto - -	210	0					
The weight lost by the produce of one acre in drying - - - - -						11485	3
64 dr. of grass afford of nutritive matter -	4	0	- -	20418	12 =	1276	2
The produce of the space, ditto - -	30	0					

From these details, therefore, this species is inferior to the Philadelphian Lyme-grass in the proportion nearly of 5 to 3. It is also much later in the production of foliage in the spring, and does not come into flower till after that species has nearly perfected its seed. It cannot therefore be recommended for the purposes of the Agriculturist.

Flowers about the latter end of July, and ripens the seed in August,

Elymus striatus.

Striated Lyme-grass.

Elymus sibiricus. Siberian Lyme-grass.

Specific character: Spike pendulous, like an arch; spikets longer than the calyx. Hort. Kew. i. p. 176.

Obs.—Culm round, smooth; leaves roughish, vagina smooth. This plant does not accord exactly with the description of the *Elymus sibiricus* of Gmelin: he says the spike is close or contracted; but in this grass the spike is mostly branched, or is in fact a panicle; the branches are confined, however, to the middle of the rachis, occupying about one-third of its length; both extremities are contracted, and spike-like. On very poor soils the branches hardly appear. The calyx is hardly half the length of the spiket. The edges of the spikets are tinged with a reddish purple colour.

Native of Siberia. Root, on a moist or clayey soil, biennial; on a sandy soil it continues several years.

Experiments.—At the time of flowering, the produce from a rich sandy soil, is,

	dr.	qr.	oz.		lbs.		
Grass, 24 oz. The produce per acre - - - - - - - -			261360	0 =	16335	0	0
80 dr. of grass weigh, when dry - -	28	0					
The produce of the space, ditto - -	134	$1\frac{2}{5}$	91476	0 =	5717	4	0
The weight lost by the produce of one acre in drying - - - - - - - -			10617	12	0		
64 dr. of grass afford of nutritive matter -	2	1					
The produce of the space, ditto - - -	13	2	9188	7 =	574	4	7

The produce of this grass is very coarse, and the weight of the crop, therefore, though considerable, is comparatively of no value. It is a native of Siberia, and withstands the effects of the severest continued frost, but not sudden changes from frost to mild weather. It requires to be sown every year, and treated as an annual. It comes into flower the second season, about the second or third week in June, and continues to emit flowering culms till autumn. The seed is ripe in about three weeks after flowering. A light rich siliceous soil appears to be best adapted to its growth. In the Hortus Kewensis, it is said to have been cultivated in 1758, by Mr. Philip Miller.

Elymus Sibiricus.

Siberian Lyme-grass.

Elymus hystrix. Rough Lyme-grass.

Specific character: Spike upright; spikets without the involucre, spreading.

Obs.—Spike compounded of two spikets at each tooth of the rachis; spikets 4-flowered, with long awns. The place of the involucre is supplied by two calluses. Linn. Spec.

Native of the Levant. Root perennial. Introduced in 1770, by M. Richard. Hort. Kew.

Experiments.—At the time of flowering, the produce from a rich siliceous sandy loam, is,

	dr.	qr.		oz.		lbs.		
Grass, 40 oz. The produce per acre - - - -				435600	0 =	27225	0	0
80 dr. of grass weigh, when dry -	40	0						
The produce of the space, ditto - -	320	0	- -	217800	0 =	13612	8	0
The weight lost by the produce of one acre in drying - - - -						13612	8	0
64 dr. of grass afford of nutritive matter -	2	2						
The produce of the space, ditto - -	25	0	- -	17015	10 =	1063	7	10

The harsh, broad, thin, light green leaves of this species, and likewise of those of the *E. striatus* and *E. Sibericus,* indicate that they are naturally inhabitants of woods or wet shady places. Grasses of this description are generally (indeed in every instance that has come under my observation) deficient in nutritive matter, and contain an excess of bitter extractive matter. Cattle appear to dislike these grasses; oxen ate the Philadelphian Lyme-grass when it was offered to them, but they refused the Striated, Siberian, and Rough Lyme grasses. From the above details, there is no authority for recommending the Rough Lyme-grass to the notice of the Agriculturist.

It flowers in the second week of July, and ripens the seed in the second week of August.

Elymus hystrix.

Rough Lyme-grass.

Elymus geniculatus. Knee-jointed Lyme-grass.

Specific character: Spike bent perpendicularly downwards, loose; calyx, bristle-shaped, spreading, longer than the spikets; leaves sharp-pointed.

Obs.—The opposite specimen shews a singular habit of this grass; the spike just before flowering, bends down by the assistance of a joint near the foot of the spike-stalk. Engl. Bot. 1586.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a sandy loam, is,

	dr.	qr.		oz.		lbs.		
Grass, 30 oz. The produce per acre	-	-	-	-	326700	0 =	20418	12	0
80 dr. of grass weigh, when dry	-	-	32	0	-	-	130680	0 =	8167	8	0
The produce of the space, ditto	-		192	0							
The weight lost by the produce of one acre in drying			-	-	-	-	-	-	12251	4	0
64 dr. of grass afford of nutritive matter	-		3	1	-	-	16590	1 =	1036	14	1
The produce of the space, ditto	-	-	24	0⅓							

The root is powerfully creeping, and the foliage is tough and coarse. The quantity of nutritive matter it affords is not considerable. It seems, therefore, to be but little adapted for useful purposes. Sir J. E. Smith, in the English Botany, informs us, that it was discovered in the salt marshes at Gravesend by Mr. Dickson, and that Mr. Curtis was the first to distinguish it from the *Elymus arenarius*, as it seems even Linnæus had confounded them.

The *Elymus arenarius* is nearly allied to this species in its general habit, but differs specifically in the spikets being pubescent, more compact, and the spike perfectly upright. The leaves are broader, culms taller and stronger, and the root is more powerfully creeping. The pubescence on the spikets, and the close order in which they are placed on the spike-stalk, with the upright habit of the spike before and after flowering, seem to be good specific distinctions; with the exception of the last, as the two first indicate an excess of saccharine matter in proportion to the other constituents of the plant, while the slender culms, distant florets, or loose spike destitute of pubescence, with thin leaves, indicate the contrary. This is the case with the two species now spoken of; the nutritive matter of the *Elymus arenarius* contains more than one-third of its weight of saccharine matter, and that of the *Elymus geniculatus* contains but a very small proportion.

M. Schrader, in the Flora Germanica, describing the *Elymus arenarius*, says—Huic affinis, at in Germania huc usque haud observata, species est *Elymus geniculatus*. Smith, *Britan.* i. p. 153.—Cui culmi altiores, graciliores; folia angustiora; spicæ sesquipedales, bipedales, laxæ; spiculæ remotæ; glumæ calicinæ lineari-setaceæ flosculis longiores.

At the time of flowering, the produce of the *Elymus arenarius* on a clayey loam, is,

	dr.	qr.		oz.		lbs.		
Grass, 64 oz. The produce per acre	-	-	-	-	697160	0 =	43572	0	0
80 dr. of grass weigh, when dry	-	-	45	0	-	-	392040	0 =	24502	8	0
The produce of the space, ditto	-	-	576	0							
The weight lost by the produce of one acre in drying			-	-	-	-	19069	8	0
64 dr. of grass afford of nutritive matter	-		5	0	-	-	54450	0 =	3403	2	0
The produce of the space, ditto	-	-	80	0							

Elymus geniculatus.

Knee-jointed Lyme-grass.

This species is therefore greatly superior to the above in produce and nutritive properties, but neither appears to have merits sufficient to recommend it for cultivation; for even though they were early in the produce of fine foliage, and grew rapidly after being cut, their strong creeping roots, which exhaust the soil very much, would preclude their introduction on the farm.

The Knee-jointed, or Pendulous Lyme-grass, flowers in the second week of July. The Sea Lyme-grass flowers about a week later. The seed is perfected in about three weeks after the time of flowering.

Dactylis patens. Spreading Cock's-foot Grass.

Specific character: Spike spreading, flowering a little on one side; florets bent like an arch; culm decumbent; leaves spreading very much.

Obs.—Introduced into England in 1781 by Mr. William Curtis. Hort. Kew. i. p. 160. Native of North America. Root perennial.

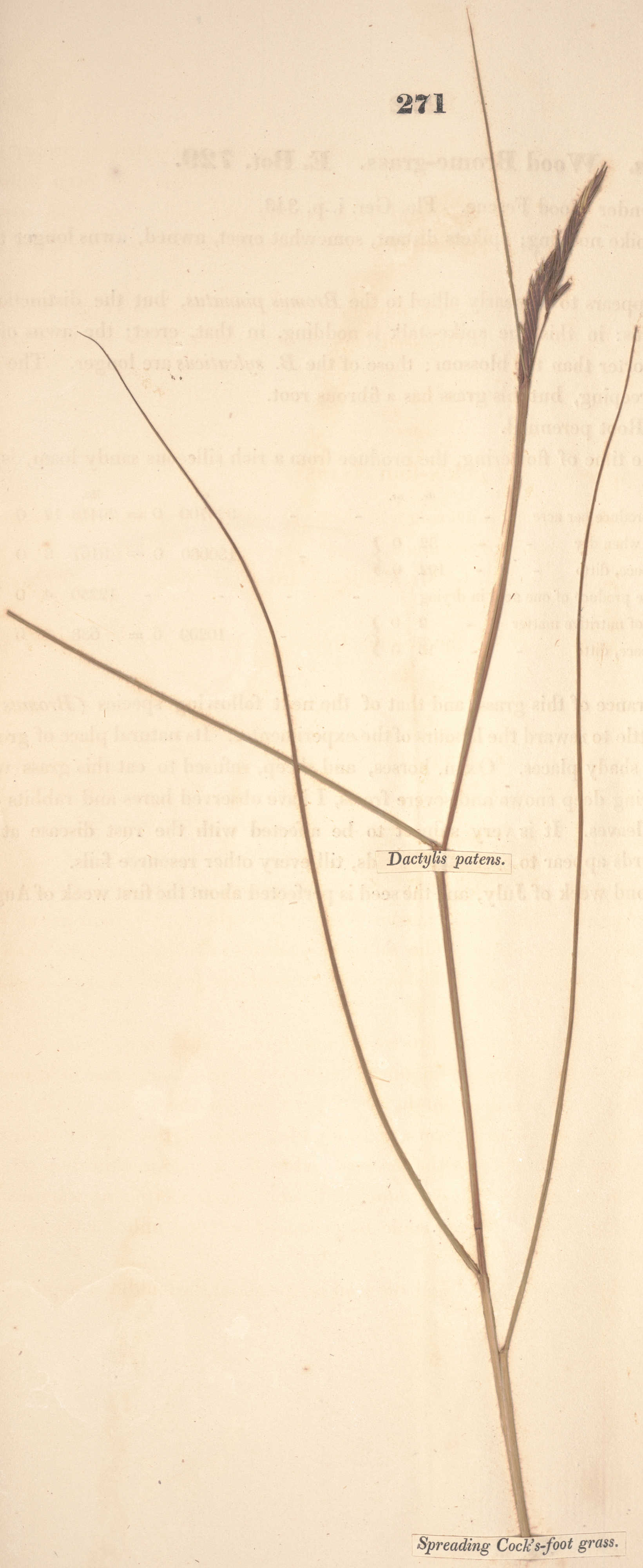
Experiments.—At the time of flowering, the produce from a rich siliceous sandy soil, is,

	dr.	qr.	oz.		lbs.	
Grass, 49 oz. The produce per acre - - - - - -			533610	0 =	33350	0
80 dr. of grass weigh when dry - -	36	0	- -	240124	8 =	15007 12
The produce of the space, ditto - -	313	$0\frac{1}{4}$				
The weight lost by the produce of one acre in drying - - - -				18342	4	
64 dr. of grass afford of nutritive matter -	2	3	- -	22928	8 =	1433 0
The produce of the space, ditto - -	33	$2\frac{2}{4}$				

This grass is very late in the production of foliage in the spring, and it does not come into flower till the month of August. The produce, considered as a single crop, is then great, but it is the only one it produces in the season. The nutritive qualities of the herbage are likewise inferior to those of most other kinds of grass. The leaves are remarkable for their length, smoothness of surface, and toughness of fibre.

I submitted a quantity of the leaves to the process used for forming flax, by steeping, drying, breaking, &c. The results were favourable, inasmuch as the clean fibre was equal in strength and softness to that of flax, but it was deficient in length; for though the leaves of the grass were as long as the plants of flax in general, yet a considerable portion of the top, or from the point of the leaf, did not stand the effects of the process. How far a little modification of the process may obviate this, another trial must determine. The only advantage that appears would result from this plant affording flax, is, that it could be produced on a soil unfit for the growth of flax or the production of corn.

It flowers in the second week of August, and the seed is ripe about the middle of September.



Dactylis patens.

Spreading Cock's-foot grass.

Bromus sylvaticus. Wood Brome-grass. E. Bot. 729.

Festuca gracilis. Slender Wood Fescue. Flo. Ger. i. p. 343.

Specific character: Spike nodding; spikets distant, somewhat erect, awned, awns longer than the husks.

Obs.—This species appears to be nearly allied to the *Bromus pinnatus*, but the distinction is nevertheless obvious: in this the spike-stalk is nodding, in that, erect; the awns of the *B. pinnatus* are shorter than the blossom; those of the *B. sylvaticus* are longer. The root of the former is creeping, but this grass has a fibrous root.

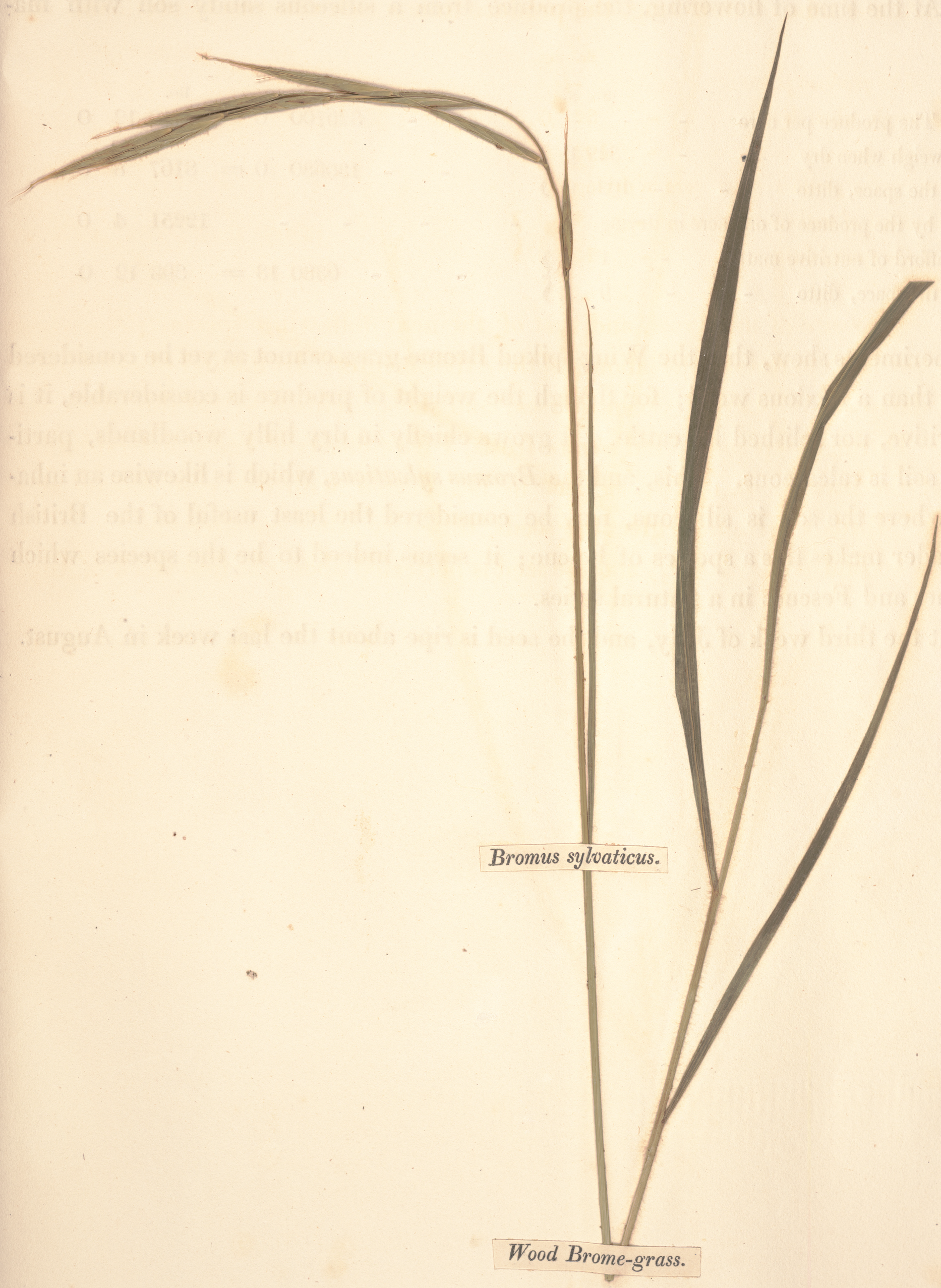
Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a rich siliceous sandy loam, is,

	dr.	qr.		oz.		lbs.		
Grass, 30 oz. The produce per acre - - - -				326700	0 =	20418	12	0
80 dr. of grass weigh, when dry - -	32	0	-	130680	0 =	8167	8	0
The produce of the space, ditto - -	192	0						
The weight lost by the produce of one acre in drying - - - -				12250	4	0		
64 dr. of grass afford of nutritive matter -	2	0	-	10209	6 =	638	1	6
The produce of the space, ditto - -	15	0						

The general appearance of this grass, and that of the next following species (*Bromus pinnatus*), promise but little to reward the labours of the experimenter. Its natural place of growth is in woods, and damp shady places. Oxen, horses, and sheep, refused to eat this grass when offered to them. During deep snows and severe frosts, I have observed hares and rabbits crop the extremities of the leaves. It is very subject to be affected with the rust disease at the time of flowering. Birds appear to neglect the seeds, till every other resource fails.

Flowers in the second week of July, and the seed is perfected about the first week of August.


Bromus sylvaticus.
Wood Brome-grass.

Bromus pinnatus. Wing-spiked Brome-grass. E. Bot. 730.

Festuca pinnata. Wing-spiked Fescue-grass. Flo. Ger. i. p. 342.

Specific character: Spike erect; spikets a little distant, awned; awns after flowering a little spreading, shorter than the husks; root creeping.

Obs.—The whole plant is of a yellowish green colour. Culms numerous, eighteen inches and more in height, upright, roundish, slightly scored, smooth and unbranched. Leaves erect, linear spear-shaped. Spike-stalk flexuose, rough; spikets rather distant, linear, at first roundish, afterwards a little compressed, many-flowered, awned, pubescent.

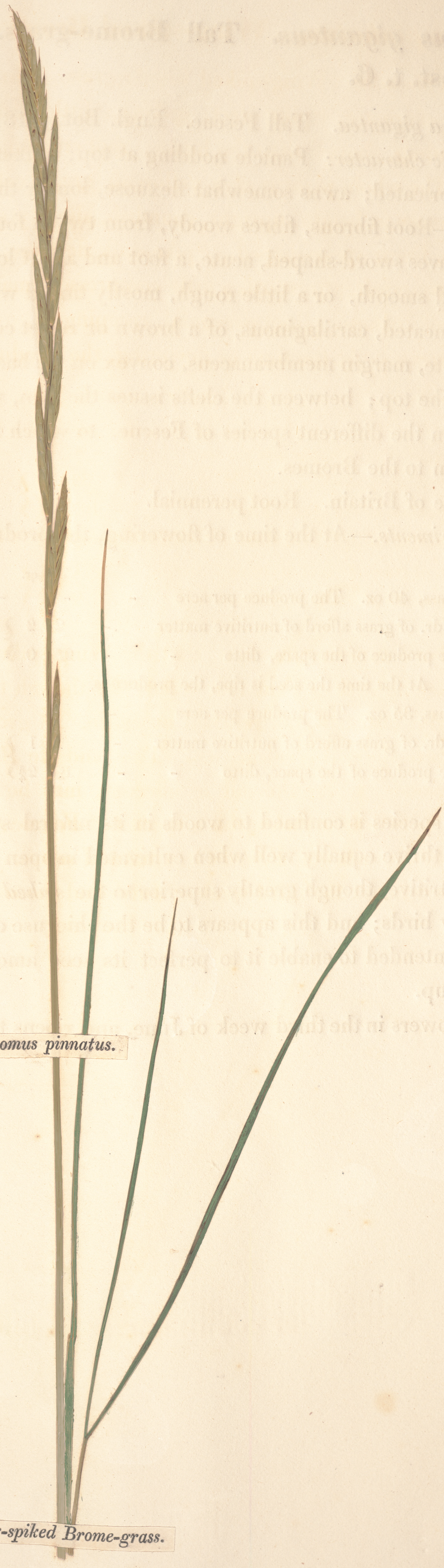
Native of Britain. Root perennial, creeping.

Experiments.—At the time of flowering, the produce from a siliceous sandy soil with manure, is,

	dr.	qr.	oz.		lbs.		
Grass, 30 oz. The produce per acre - - - - - -			326700	0 =	20418	12	0
80 dr. of grass weigh when dry - -	32	0					
The produce of the space, ditto - -	192	0	130680	0 =	8167	8	0
The weight lost by the produce of one acre in drying - - - -			12251	4	0		
64 dr. of grass afford of nutritive matter -	1	1					
The produce of the space, ditto - -	9	1¾	6380	13 =	398	12	0

The above experiments shew, that the Wing-spiked Brome-grass cannot as yet be considered in any other light than a noxious weed; for though the weight of produce is considerable, it is neither early, nutritive, nor relished by cattle. It grows chiefly in dry hilly woodlands, particularly where the soil is calcareous. This, and the *Bromus sylvaticus*, which is likewise an inhabitant of woods, where the soil is siliceous, may be considered the least useful of the British grasses. M. Schrader makes this a species of Fescue; it seems indeed to be the species which connects the Bromes and Fescues in a natural series.

It flowers about the third week of July, and the seed is ripe about the last week in August.



Bromus pinnatus.

Wing-spiked Brome-grass.

Bromus giganteus. Tall Brome-grass. Flo. Ger. 362; Curt. Lond.; Host. t. 6.

Festuca gigantea. Tall Fescue. Engl. Bot. t. 1820.

Specific character: Panicle nodding at top; spikets spear-shaped, compressed, naked; florets imbricated; awns somewhat flexuose, longer than the husks; leaves naked.

Obs.—Root fibrous, fibres woody, from two to four feet high, erect, round, striated, smooth. Leaves sword-shaped, acute, a foot and a half long, apex nodding. Sheath roundish, striated smooth, or a little rough, mostly tinged with purple at the base. Sheath-scale short, truncated, cartilaginous, of a brown or russet colour. Outer husk of the corolla lanceolate, acute, margin membranaceus, convex on the back, keeled above, generally 5-nerved, cloven at the top; between the clefts issues the awn, which is a continuation of the middle nerve, as in the different species of Fescue, to which it is evidently as much, if not nearer allied than to the Bromes.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a rich siliceous sandy soil, is,

	dr.	qr.	oz.		lbs.		
Grass, 40 oz. The produce per acre - - - - -			435600	0 =	27225	0	0
64 dr. of grass afford of nutritive matter -	2	2					
The produce of the space, ditto - -	25	0	17015	10 =	1063	7	0
At the time the seed is ripe, the produce is,							
Grass, 35 oz. The produce per acre - - - -			381150	0 =	23821	14	0
64 dr. of grass afford of nutritive matter -	2	1					
The produce of the space, ditto - -	19	2¾	13399	11 =	837	7	11

This species is confined to woods in its natural state; but it continues in the soil, and appears to thrive equally well when cultivated in open situations. It is a coarse grass, and but little nutritive, though greatly superior to the *spiked* and Wood Brome Grasses. The seeds are eaten by birds; and this appears to be the chief use of the plant, its large structure being, apparently, intended to enable it to perfect its seed among bushes, where it would be otherwise choked up.

It flowers in the third week of June, and ripens the seed about the middle and latter end of July.

Bromus giganteus.

4 B

Tall Brome-grass.

Agrostis ramosissima. Lateral-branching Bent-grass.

Specific character: Panicle spike-like, heaped; calyx shorter than the corolla; culms branching at each joint.

Obs.—This is nearly allied to the *Agrostis Mexicana;* the culms are taller and more woody, lateral branches more numerous, shorter, and pointing one way; leaves smoother than those of the *A. Mexicana;* panicle more compact, or heaped together, which gives it more the appearance of a spike; calyx shorter than the corolla, with very few hairs at the base, which are long and numerous in the *Mexicana.* Flowers a month later than that species.

Experiments.—At the time of flowering, the produce from a strong clayey loam, is,

	dr.	qr.	oz.		lbs.	
Grass, 42 oz. The produce per acre - - - - -			457380	0 =	28586	4
80 dr. of grass weigh when dry - -	32	0				
The produce of the space, ditto - -	268	$0\frac{4}{5}$	182952	0 =	11434	0
The weight lost by the produce of one acre in drying - - - -			17152		4	
64 dr. of grass afford of nutritive matter -	2	0				
The produce of the space, ditto - - -	20	$0\frac{3}{4}$	14293	2 =	893	5

This is one of the latest flowering grasses. It is remarkable for the number of branches that issue from the joints of the stem; and the woody substance of the culms makes it approach to the nature of a shrub. It affords little herbage till the beginning of summer, and flowers at so late a period of the season, that excepting once, I have never been able to procure any perfect seed, the frost generally destroying the panicles before the seed be perfected. The herbage is killed by frost, but the roots suffer nothing from its effects. It is propagated by parting and planting the roots early in the spring, or late in the autumn. The above details shew that it is neither very productive nor nutritive.

Flowers in the first or second week of October.

Agrostis ramosissima.
Lateral-branching Bent.

Poa decumbens. Decumbent Meadow-grass. Engl. Bot. 792.

Festuca decumbens. Decumbent Fescue. Flo. Dan. 162; Willdw. i. 424.

Specific character: Panicle simple, contracted, few-flowered; spikets oval-oblong, 3-4 flowered, calyx nearly equal to the florets; sheaths of the leaves hairy; root somewhat creeping.

Obs.—Culms decumbent, from ten to eighteen inches long; root-leaves flat, hairy on the upper surface, especially at the base; stem-leaves shorter; sheaths villose towards the top, a little compressed, striated; the place of the sheath-scale is supplied with a row of short hairs; panicle very simple, little branches alternate, simple, shortest one-flowered, the longest one two-flowered; flowers from three to four, the terminating one always sterile. Flo. Ger.; Leers, &c.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a clayey loam, is,

	dr.	qr.		oz.		lbs.		
Grass, 8 oz. The produce per acre -	-	-	- -	87120	0 =	5445	0	0
64 dr. of grass afford of nutritive matter -	1	2	- -	2041	14 =	127	9	14
The produce of the space, ditto -	3	0						
The produce of latter-math, is								
Grass, 5 oz. The produce per acre -	-	-	- -	54450	0 =	3403	2	0
64 dr. of grass afford of nutritive matter -	1	1	- -	1063	7 =	66	7	7
The produce of the space, ditto - -	1	2¼						

It is chiefly confined to high wet barren pastures, though sometimes found in those that are dry. On some particular spots among the trees in Woburn-park, it is found growing in company with the *Carex axillaris.* It appears to be but little susceptible of improvement by being transplanted to a richer soil; as the produce, from a rich black loam, scarcely exceeded the above stated produce, from a clayey loam, without any manure. It never appeared to be cropped by the deer in the park. It is late in the production of foliage in the spring, and produces little after-grass: it is not, therefore, to be recommended for cultivation.

It flowers about the third and fourth weeks of July, and the seed is ripe in the middle and towards the latter end of August, according as the soil and season are favourable to its growth.

From the above details it is evident, that if we except one, or at most two species of grass, the whole natural produce of bogs, and low-lying stagnant meadows, is of little or no value to the possessors. Such lands, however, by the simple process of forming them into water-meadows, have had their original value, which is, generally, from one to five shillings, increased to forty, and frequently to sixty shillings, per acre. From the magnitude, and the short space of time in which the rise in the value of land is thus permanently effected, the conversion of waste bogs to irrigated meadows, may justly be ranked with the very first improvements in this branch of practical agriculture; and were it not from the local nature of the lands in question, when it is considered that in numerous instances, with a spade only, the process may be begun and finished, it may justly perhaps maintain a claim for the first place in improvements of modern Agriculture,

in any branch whatever. At least it appears difficult to find any other improvement in this art, that so speedily, permanently, and at so moderate an expence, raises the value of land to the degree now mentioned. It is hardly possible, I should conceive, to witness one of these wastes converted into a rich fertile meadow in the short compass of two seasons, without feeling a conviction something like this.

In forming a water-meadow, the chief point to be obtained is a perfect command of the water, that it may be admitted on the land, and completely carried off at pleasure; for without this, it will be found a vain and useless labour, as none of the valuable species of grass will thrive, or even exist in this kind of soil, under any other condition.

Lands lying on declivities, are seldom converted into water-meadows, from the want of a regular and sufficient supply of water in such situations. Bogs and low marshy grounds are generally, in their natural state, the least profitable of soils, but are capable, by means of irrigation, of having their value increased to a higher degree than any other waste lands.

Water-meadows situated on declivities, are termed *catch-work meadows;* and those formed out of bogs and low level land, are styled *flowing meadows.* The last requires the most art and labour in its formation, on account of the difficulty that sometimes occurs in getting a command of the water. This is generally effected by throwing up the land in high ridges, with deep drains between them. A main carriage is then taken out of the river, at a level sufficiently high to command the tops of the ridges. Along the top of each ridge, an open drain or trench is made to communicate with the main water-carriage. These little water-carriages being furnished with moveable *stops* of earth, disperse the water on each side of the ridge, and is received below by the drains, which conduct it to other parts of the same meadow. The point of importance next to that of having a perfect command of water, at least as far as the growth and prosperity of the superior grasses is concerned, is the size of the ridges. Where there is a plentiful supply of water, as from a river, the ridges may be from forty to fifty feet broad, and seventy in length; but when the supply of water depends upon a small brook, or upon a reservoir formed by land-drains, thirty feet in width and fifty in length, are supposed to be the best dimensions. The height of the ridges seems to be a point of considerable importance. I have invariably observed, that all the superior grasses inhabit the crowns of the ridges, extending generally to eight feet on each side of the water-carriage, and the inferior grasses occupying the lower extremities of the ridges. When the ridges are nearly level, much less water is required to irrigate the land; but unless the subsoil is porous, the produce will be found much inferior to what it would have been, had the ridges been raised to a proper height. In all the observations I have made while examining different water-meadows at various periods of the seasons, the most productive in the superior grasses, were those where the ridges were formed thirty-three feet in width and two feet and a half in height, that is, from the level of the furrow to the crown of the ridge. But when the situation is very low and moist, and the soil deep, as in the instance of a peat-bog, or where the subsoil is tenacious, the heighth of the ridge should be from two to three feet.

From numerous statements published by gentlemen who have made these improvements, the expences of forming land into water-meadows, appear to be from four to twenty pounds per acre, varying thus according to the local circumstances under which the improvement is made. The yearly expences for repairs, appear likewise to be from three to nine shillings per acre. The

value of such lands, by these means, has been increased from one to twelve shillings, their original value, to forty and sixty shillings per acre. But when connected with a breeding flock of sheep, the advantages derived from these meadows is hardly to be estimated, for they produce a full bite of grass at least three weeks earlier than the common pastures, and that at a season when every other kind of food is scarce.

Irrigated meadows seldom or never require any manure, the water being found sufficient to produce that extreme degree of fertility for which they are remarkable*.

* Sir H. Davy gives the theory of the effects of water in increasing the fertility of meadows. He says they depend on many causes, some chemical, some mechanical. "When land has been covered by water in the winter, or in the beginning of spring, the moisture that has penetrated deep into the soil, and even the subsoil, becomes a source of nourishment to the roots of the plant in summer, and prevents those bad effects that often happen in lands in their natural state, from a long continuance of dry weather.

"When water used in irrigation has flowed over a calcareous country, it is generally found impregnated with carbonate of lime; and in this state it tends in many instances to ameliorate the soil.

"Even in cases where the water used for flooding is pure, and free from vegetable or animal substances, it acts by causing the more equable diffusion of nutritive matter existing in the land; and in very cold seasons, it preserves the tender roots and leaves of the grass from being affected by frost.

"Water is of greater specific gravity at 42° Fahrenheit, than at 32°, the freezing point; and hence in a meadow irrigated in winter, the water immediately in contact with the grass, is rarely below 40°; a degree of temperature not all prejudicial to the living organs of plants.

"In general, those waters which breed the best fish are the best fitted for watering meadows; but most of the benefits of irrigation may be derived from any kind of water. It is however a general principle, that waters containing ferruginous impregnations, though possessed of fertilizing effects, when applied to calcareous soils, are injurious on soils that do not effervesce with acids; and that calcareous waters which are known by the earthy deposit they afford when boiled, are of most use on siliceous soils containing no remarkable quantity of carbonate of lime."—*Agricultural Chemistry*, page 305, et seq.

The proper business of irrigation begins in October, and is carried on till April, according to circumstances. In cold backward situations it is continued latest, and in warmer soils it is generally finished in February. As soon as the latter-math is eaten bare, the water-carriages are cleared out, and the stops and sluices made good. The water is then admitted on the land, and suffered to remain for two or three weeks, with a dry interval of a day or two; or, according to others, the water is continued on the meadow two weeks at first, then laid dry for one week, and again laid under water for two weeks more. The state of the grass affords the best rule to judge of the frequency of waterings. It is a general principle to make the meadows as dry as possible between every watering, and to stop the water the moment any scum appears on the surface, for that indicates the land has had water enough; in fact, it is caused by the fermentation excited by the decay of the grass. As soon as the land has been sufficiently dry after the last watering in February or March, the early grass, of which there is always an abundance, is consumed by ewes, and lambs, if a breeding flock of sheep is kept. In order to prevent the sheep from trampling too much of the grass at first, some Farmers use hurdles, by which they portion out the consumption of a day. Open spaces are left in the hurdles, to give the lambs free range of the meadow at large. Mr. Davis says, that one acre of good grass will be sufficient for five hundred couples for a day. It is usual to leave off depasturing the meadows about the beginning of May, when the water is again admitted to prepare the land for a crop of hay. Two days flooding at this season is all that the land can receive without injury; it is then laid dry, and the process may be said to be finished for that season. Six weeks is usually sufficient to produce the crop of hay; so rapid is vegetation in these meadows.

The following is a statement of the produce of a water-meadow of nine acres, belonging to His Grace the Duke of Bedford.

1803. Stocked with twelve score of sheep, and it kept them three weeks.

April 16, Shut up for hay.

June 23, Cut the crop for hay, supposed to be about two tons per acre.

Aug. 20, Cut the second crop for hay, supposed to be about one ton and a half per acre.

Sept. 16, Stocked it with four score of fat sheep: three weeks after that it was depastured with lean bullocks, as long and as often as they could find food.

1804. Feb. 27, Stocked with eight score and four lamb hogs; they have now (April 28, the time this account was drawn up) been nine weeks in it. It had more and better water this last winter than that before; but from the want of grass upon the farm, it was in this instance eaten longer than it otherwise would have been.

All the superior perennial grasses thrive under irrigation, when the meadow is properly formed. The following species of grass I have invariably found to constitute the produce of the *best* water-meadows. Meadow fox-tail, *(Alopecurus pratensis);* round panicled cock's-foot, *(Dactylis glomerata);* field brome-grass, *(Bromus arvensis);* meadow fescue, *(Festuca pratensis);* these occupied the crowns and sides of the ridges. The furrows were stocked with the creeping bent, *(Agrostis stolonifera);* marsh bent, *(Agrostis palustris);* hard fescue, *(Festuca duriuscula);* lesser variety of meadow cat's-tail, *(Phleum pratense,* var. *minus);* woolly soft-grass, *(Holcus lanatus);* rough-stalked meadow-grass, *(Poa trivialis);* meadow fescue, *(Festuca pratensis);* and a small admixture of other species, which were thinly scattered over every part of the ridge; these were, meadow barley, *(Hordeum pratense);* yellow or golden oat, *(Avena flavescens);* crested dog's-tail, *(Cynosurus cristatus);* rye-grass, *(Lolium perenne);* sweet-scented vernal-grass, *(Anthoxanthum odoratum);* tufted vetch, *(Vicia cracca);* with a larger proportion of the tall oat-like soft-grass, *(Holcus avenaceus).* The meadow cat's-tail, *(Phleum pratense),* I never met with in irrigated meadows, but only the lesser variety of it, and that not very prevalent. It is a very common grass, however, in some natural meadows that I have had an opportunity to examine. The soil of the water-meadows which produced the above grasses, was either a deep active peat, incumbent on a siliceous sand, or a sandy loam on a chalky or gravelly subsoil. In some irrigated meadows, that I examined, where the ridges were formed nearly flat, and the soil consisted of a sandy loam on a retentive clayey subsoil, the following grasses constituted the chief produce: crested dog's-tail, *(Cynosurus cristatus);* creeping-rooted soft-grass, *(Holcus mollis);* rye-grass, *(Lolium perenne);* meadow barley, *(Hordeum pratense);* tall oat-like soft-grass, *(Holcus avenaceus);* sweet-scented vernal; and soft brome-grass, *(Holcus mollis).* Though this soil was not entirely destitute of the superior kinds of grasses mentioned as the produce of the former meadows, yet they were in very small quantity, being thinly scattered over certain portions of the ridges only. It seems probable, that the flatness of the ridges tended much to prevent these grasses from flourishing on the sandy loam incumbent on clay, for I invariably found the head ridges, which had been raised considerably above the level of the rest, as the first conductors of the water, were plentifully stocked with the superior grasses, and as productive of grass, as those of the first-mentioned meadows.

Valuation.

1803.	March 29,	240 sheep three weeks, at sixpence per head - - - - - -	£18 5 0
		Spring food per acre, at 2*l*,	
	June 23,	18 ton of hay, at 4*l*. - - - - - - -	72 0 0
	Aug. 20,	13½ ditto, at 4*l*. - - - - - - - - -	56 0 0
	Sept. 16,	80 fat sheep, three weeks at fourpence - - - - -	4 0 0
		Lean bullocks	
			£150 5 0
1804.	Feb. 27,	164 hog-sheep, nine weeks at fivepence - - - - -	30 15 0
		Spring food per acre, 3*l*. 8*s*. 4*d*.	

For full details respecting the construction and value of irrigated meadows, consult Brown's Rural Affairs, page 263; Young's Annals; Agricultural Surveys, viz. *Middlesex,* by Marshall, i. p. 284; *Wilts,* by Davis; *Dorset,* by Coldridge; *Hants,* by Driver; *Brecknock,* by Clark; Communications to the Board of Agriculture, vol. iv.

The hay of water-meadows is generally supposed to be less nutritious than the hay of rich permanent pasture land. I compared the quantity of nutritive matter afforded by these grasses, produced under irrigation, and those produced in rich permanent pasture land. The difference was much less than I had expected. An instance may suffice.

Rye-grass *(Lolium perenne)*, at the time of flowering, taken from a water meadow that had been fed off with sheep till the end of April, afforded of nutritive matter - - -	72 grains.
The same weight of this grass, taken from a rich old pasture that had been shut up for hay about the same time, afforded of nutritive matter - - - - - -	95
The same grass from the meadow that had not been depastured in the spring, afforded	110
That from the rich pasture that had not been depastured, afforded - - -	120

A water-meadow may be said to be a hot-bed for grass. The rapidity with which vegetation advances by the process of irrigation, justifies the comparison. The small deficiency of nutritive matter in water-meadow hay, is what might be expected from such a cause; as we find it exemplified by daily experience, in the instances of esculent vegetables that are forced beyond their natural habits. The same effects are produced by the application of an excess of manure.

On a spot, in a field of artificial pasture, where a large portion of cow-dung had been accumilated, the grass was extremely rank, and of a very deep green colour, distinguishable from the rest of the Rye-grass pasture at a considerable distance.

Four ounces weight of this luxuriant tuft was submitted to experiment, and it afforded of nutritive matter - - - - -	72 grains.
The same quantity of grass from a moderately rich soil, that surrounded this luxuriant patch, afforded of nutritive matter - - -	122
In another trial, the same species of grass, produced on a soil entirely destitute of manure, afforded of nutritive matter - - - -	95
On the same soil excessively manured, the grass afforded only - -	50
Common Quaking-grass, on a soil moderately enriched, afforded fourteen ounces of grass, the given weight of which contained of nutritive matter -	90
On a poor siliceous sandy soil incumbent on clay, it afforded sixteen ounces of grass, the given weight of which afforded - - -	80
From a soil consisting almost of pure clay, the produce of grass was twelve ounces, the usual weight of which afforded of nutritive matter - -	69
Tall oat-like soft-grass *(Holcus avenaceus)*, from a clayey loam moderately manured, was twenty-three ounces of grass, the given weight of grass contained	84
From a soil almost pure clay, the produce of grass was thirteen ounces, four of which afforded of nutritive matter - - - -	89
From a siliceous sandy soil, with a small portion of manure, the produce was ten ounces of grass, the given quantity afforded - - -	80
From a heath soil, the produce of grass was eight ounces, four of which afforded of nutritive matter - - - - - -	83

In all these trials the grasses were of the same age (two year old plants), and submitted to the chemical process at the same stage of growth.

When a water-meadow is formed, if the original turf is fine, and free from the coarse inferior grasses, it will be found the most expeditious way to obtain a good sward, to replace the turf on the new-formed ridges, and afterwards to give a top-dressing with compost, and then to sow a mixture of the following grass-seeds: *Alopecurus pratensis, Dactylis glomerata, Festuca pratensis, Poa trivialis, Holcus avenaceus,* and a small proportion of the *Agrostis stolonifera latifolia.* The quantity of seed per acre, must be regulated by the state of the turf. Consolidating the surface with a heavy roller would be of infinite service, but the turf is often displaced by the operation. A light bush-harrow, therefore, drawn over the surface to cover the seeds, or rather to draw them into the interstices of the turfs, followed by a light wooden roller drawn by men, in the same manner as the bush-harrow, will be found the best mode of management.

It is customary, when forming a water-meadow out of inert peat-bogs, to throw the coarse surface (composed of segs and rushes chiefly), promiscuously together to form the ridges; but it would surely be more advantageous to pare and burn a surface of this nature, as it affords an abundance of excellent ashes; and without these, or a substitute perhaps of a more expensive nature, to apply as a top-dressing, previous to sowing the seeds, soils of this description remain for years in a state of comparative sterility. Caustic or hot lime, is found to be the very best simple manure that can be applied to inert peat-moss, to bring it into a state of activity. When the ridges are formed of this soil, the surface should have a copious dressing of hot lime, which may be with advantage incorporated with the surface soil by a common harrow, and afterwards suffered to remain unmolested for a few weeks. A thick covering of the ashes, mixed with the cleanings of roads, waste headlands, &c. should then be applied; and the seeds of the fore-mentioned grasses, with a larger proportion of the *Agrostis stolonifera,* and an equal proportion of the *Agrostis palustris,* sown at the rate of five bushels to the acre: the ground should be well rolled. I have made several trials to overcome the sterile nature of this soil (see No. XII. page lxiv. Introd.), but in none was I successful, except in that where the above means were adopted. The best season for sowing the seeds of the grasses, is in the beginning of May or early in August. It may be unnecessary to remark, that if the soil becomes very dry, previous to the vegetation of the seed, which is seldom the case in lands of this nature, a gentle watering for one day, will greatly promote the progress of vegetation; provided it can be effected without displacing any of the surface-dressing which covers the seed.

IV.

Of the different Grasses, and other Plants, adapted for the Alternate Husbandry.

The grasses, and other plants, best fitted for alternation, as green crops with grain, are such as arrive at perfection in the shortest space of time, or within the compass of two years; such as have their leaves broad and succulent, and that do not quickly run to seed. Plants of this description are supposed to produce the greatest weight of herbage at the least expence to the soil.

It is a curious and well-known fact, that any species of plant that has continued till its natural decay on a particular soil, cannot be again immediately reared with equal success on the same spot, till some other crop intervene; but that a *different* species of vegetable will there succeed better, for its peculiar period of life, than it would on a soil naturally better adapted to its growth, where it had just attained to perfect maturity. This holds good with respect to annual plants as well as to those that continue to live many years. But it is better seen in the former, as their habits and duration in the soil are oftener and more directly within the reach of common observation.

On this antipathy of plants seems to depend the theory of alternate cropping with green crops and grain, varying in some measure according to the circumstances of soil and climate; but the principle appears to remain the same.

On analyzing a soil immediately before and after producing an impoverishing crop, the results of such analysis do not point out any diminution in the weight or proportions of its constituents, sufficient to account for the weight of vegetable matter produced. The decomposing animal and vegetable matters of the soil, are the only constituents wherein a sensible loss is perceived.

M. Braconnot grew plants in substances free from any kind of soil, as in flowers of sulphur, and in metal. He supplied the plants with distilled water only. They arrived, by these means, to a perfect state of maturity. The produce was submitted to careful analysis; and the results shewed that the different vegetables so produced, contained all the constituents of the different species, precisely the same as when the plants were cultivated on their natural soils*.

Some have supposed that the antipathy of plants arises from the roots depositing a noxious matter in the soil. And according to the experiments of M. Burgmanns, Oats are thus killed by the Field Saw-wort; Wheat by the Blue Erigeron; Flax by the Corn Scabious, and the Purple Spurge; and Buck-wheat by the Corn Spurry.

The analysis of a plant, therefore, and of the soil which produced it, appear insufficient to account for the true cause of the impoverishing principle of vegetables to the soil, and why one species should exhaust it more than another.

Some useful information, however, on this very interesting point, may probably be drawn from facts obtained by daily practice and observation in the garden and the farm.

* Annales de Chimie, Fev. et Mars, 1808.

	Green Food. lbs.	Nutritive Matter. lbs.
Mangel-wurzel, or white beet, *(Beta cicla)*, produces upon a suitable soil, or a deep rich loam, on an average, twenty-five tons of green food per acre, every pound weight of which contains 390 grains of nutritive matter, and therefore per acre - - - - - - -	56000 -	3120
Carrots, *(Daucus carota)*, produce upon a deep light loam, on an average, eleven tons, every pound of which contains 750 grains of nutritive matter - - - - - -	24640 -	2640
Potatoes, *(Solanum tuberosum)*, produce upon a fresh loam of intermediate quality as to moisture and dryness, on an average, 15 tons per acre, affording of nutritive matter per pound, 1440 grains	33600 -	6912
The common field or white turnip, *(Brassica rapa*, var.), affords from a sandy loam, upon an average per acre, 16 tons of green food, a pound of which contains 320 grains of nutritive matter	35840 -	1638
The Swedish turnip, or ruta baga, *(Brassica rapa*, var.), produces on a favourable soil, or a strong loam, on an average, 13 tons per acre, a pound weight of which affords of nutritive matter 440 grains - - - - - - - - - -	29120 -	1830
Cabbages, *(Brassica oleracea*, var.), which delight in a rich strong loam, afford of green food, on an average per acre, 25 tons, every pound of which contains 540 grains of nutritive matter	56000 -	4320
Kohl rabi, *(Brassica oleracea*, var.), the produce from a soil similar to that for cabbages, or Swedish turnips, is on an average 14 tons per acre*, and affords of nutritive matter per pound, 420 grains - - - - - - - - - -	31360 -	1881

If a plant, therefore, impoverishes the soil in proportion to the weight of vegetable substance it produces on a given space of ground, the following will be the order in which the plants just mentioned exhaust the land.

Mangel-wurzel - - - -	25	The proportions which they bear to each other with respect to weight of produce.
Cabbages - - - - -	25	
White Turnip - - - -	16	
Potatoes - - - -	15	
Kohl-rabi - - - -	14	
Swedish Turnip - - -	13	
Carrots - - - - -	11	

Experience has long since proved, that Carrots exhaust the soil in a much greater degree than White Turnips, though, by this mode of judging, they impoverish land in a less degree than any of these plants. But when we take the weight of nutritive matter which a plant affords from a given space of ground, the results are very different, and will be found to agree with daily experience in the garden and on the farm.

Potatoes - - - -	63	The proportion in which they stand to each other, with respect to the weight of nutritive matter per acre, and in exhausting the land.
Cabbages - - -	42	
Mangel-wurzel - - -	28	
Carrots - - - -	24	
Kohl-rabi - - - -	17	
Swedish Turnip - - -	16	
Common Turnip - - -	14	

* The average of some of these crops may be thought too small perhaps, but from information with which I have been favoured from extensive Cultivators, and careful comparisons of the produce, as stated in the Agricultural Surveys, and in Mr. Young's Annals, I believe the above correct.

The effects of some plants are only to impoverish the soil for an immediate succession of the same plant; while others have the property of exhausting the land, not only for an immediate succession of themselves, but likewise for every other kind of vegetable.

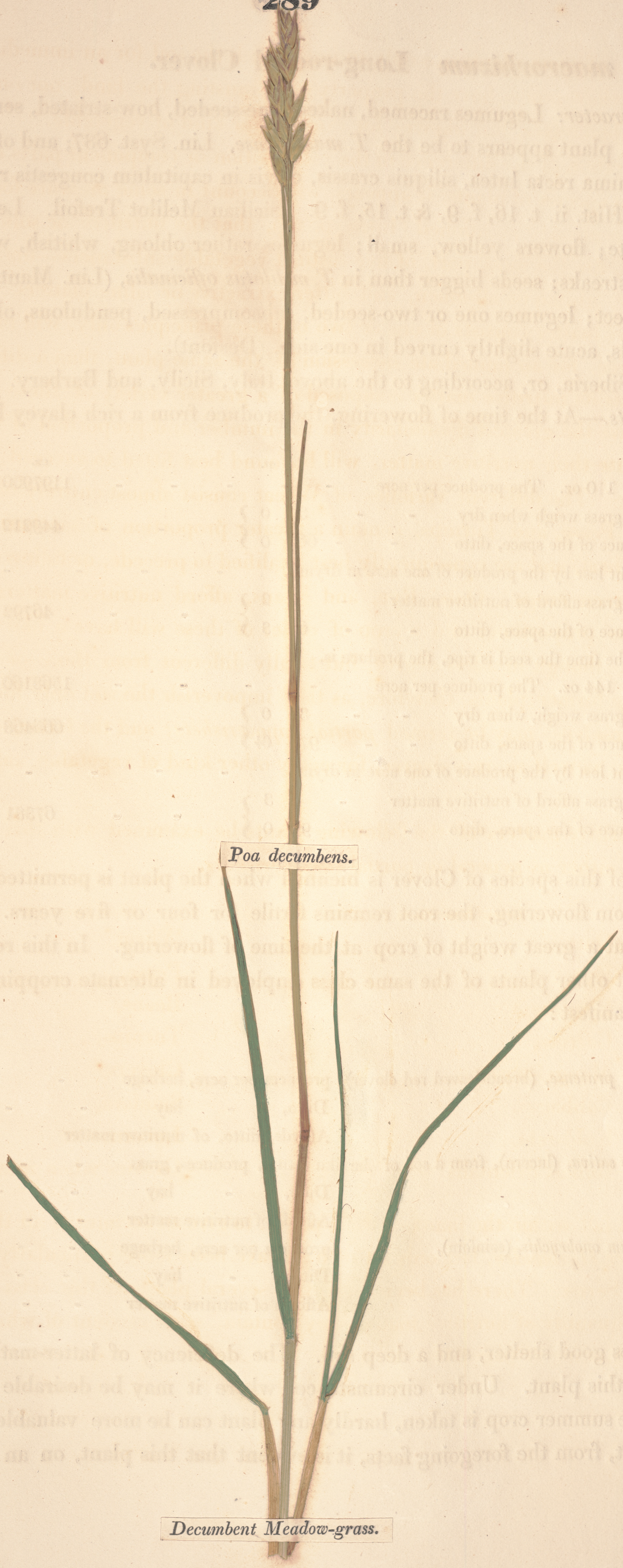
A consideration of the difference in the composition or component parts of the nutritive matter of different species of plants, it appears, will account in some measure for this property.

It has been already mentioned (Intro. p. vi.), that the nutritive or soluble matter of vegetables consists, for the most part, of five distinct vegetable substances—mucilage or starch, saccharine matter, gluten or albumen, and bitter extractive or saline matters. A plant, therefore, whose nutritive matter consists of one or two of these principles only, will impoverish the soil in a greater degree, for an immediate succession of the same plant, than a different species of vegetable that has its nutritive matter composed of a greater variety of these substances. Hence plants that have the greatest dissimilarity in the number and proportion of vegetable principles which constitute their nutritive matter, will be found best fitted to succeed each other in alternate cropping. The different varieties of Wheat consist almost entirely of starch and gluten, while Barley, Pease, and Turnips, contain a greater proportion of saccharine matter which is wanting in Wheat, and are consequently best qualified to precede, or follow that grain, in alternation with green crops. Oats, Rye, and Beans, afford nutritive matters similar to Wheat, though in less proportion; and a crop of either of these will have a like effect on the soil as that of Wheat, though in a less degree, but totally different from those of Barley, Pease, and Turnips. The former plants, therefore, as they impoverish the soil only for an immediate succession of themselves, may be termed *partial impoverishers;* and the latter, exhausting the land for themselves, as well as, in a degree, for every other kind of vegetable, may be called *general impoverishers.*

If the nutritive matters of the following plants be examined with this view, they will be found to rank either as general or partial impoverishers.

General Impoverishers.	Partial Impoverishers.
Oats,	Wheat,
Rye,	Pease,
Potatoes,	Beans,
Carrots,	Turnips,
Mangel-wurzel,	Clovers,
Cabbages,	Sainfoin,
Kohl-rabi,	Lucern,
Bunias orientalis.	Grasses when mown.

It does not fall within the limits of these pages, to give an account of all the plants employed in the *Alternate Husbandry*, but only of such as have been more particularly submitted to experiment in this Series. There has been, however, several plants of this class made trial of, with respect to the quantity of nutritive matter they contain, some account of which will be found in the Notes, beginning at page 310.



Poa decumbens.

Decumbent Meadow-grass.

Trifolium macrorhizum Long-rooted Clover.

Specific character: Legumes racemed, naked, one-seeded, bow-striated, semi-ovate, stem erect.

Obs.—This plant appears to be the *T. massanense,* Lin. Syst. 687; and of Morison, the Melilotus minima recta lutea, siliquis crassis, curtis in capitulum congestis radiatis semine fænugræci. Hist. ii. t. 16, f. 9, & t. 15, f. 9. Sicilian Melilot Trefoil. Leaves ternate, fleshy, subserrate; flowers yellow, small; legumes rather oblong, whitish, wrinkled, with semicircular streaks; seeds bigger than in *T. melilotus officinalis,* (Lin. Mant.); racemes axillary, short, erect; legumes one or two-seeded, subcompressed, pendulous, oblong, attenuated at both ends, acute slightly curved in one side, (Desfont).

Native of Siberia, or, according to the above, Italy, Sicily, and Barbary. Root biennial.

Experiments.—At the time of flowering, the produce from a rich clayey loam, is,

	dr.	qr.	oz.		lbs.	
Herbage, 110 oz. The produce per acre - - - - -			1197900	0 =	74868	12
80 dr. of grass weigh when dry - -	30	0	- -	449212	0 =	28075 12
The produce of the space, ditto - -	660	0				
The weight lost by the produce of one acre in drying - - - -					46793	0
64 dr. of grass afford of nutritive matter -	2	2	- -	46792	15 =	2924 8
The produce of the space, ditto - -	68	3				
At the time the seed is ripe, the produce is,						
Herbage, 144 oz. The produce per acre - - - -			1568160	0 =	98010	0
80 dr. of grass weigh, when dry - -	34	0	- -	666468	0 =	41654 4
The produce of the space, ditto - -	979	0⅕				
The weight lost by the produce of one acre in drying - - - - -					56355	12
64 dr. of grass afford of nutritive matter -	2	3	- -	67381	14 =	4211 5
The produce of the space, ditto - -	99	0				

The root of this species of Clover is biennial when the plant is permitted to perfect its seed; but if kept from flowering, the root remains fertile for four or five years. It produces little after-grass, but a great weight of crop at the time of flowering. In this respect it is much superior to most other plants of the same class employed in alternate cropping, as the following particulars manifest:

		lbs.
Trifolium pratense, (broad-leaved red clover),	produces per acre, herbage - - -	49005
	Ditto, - hay - - -	12251
	Affords, ditto, of nutritive matter - -	1914
Medicago sativa, (lucern), from a soil of the like nature,	produces, grass - - - -	70785
	Ditto, - hay - - -	28314
	Affords of nutritive matter - - - -	1659
Hedysarum onobrychis, (sainfoin), -	produces per acre, herbage - - - -	8848
	Ditto, - hay - - - - -	3539
	Affords of nutritive matter - - - -	345

It requires good shelter, and a deep soil. The deficiency of latter-math takes much from the merits of this plant. Under circumstances where it may be desirable to plough up the land after the summer crop is taken, hardly any plant can be more valuable than this one; as in this respect, from the foregoing facts, it is evident that this plant, on an equal soil, affords

Trifolium macrorhizum.

Long-rooted Clover.

twice the quantity of nutritive matter of that afforded by the Broad-leaved Clover. The produce of Lucern, in quantity, comes nearer to this Clover, but it is inferior in nutritient qualities. The long continuance of Lucern in the soil, is therefore the chief advantage it possesses over this plant; however, when that, or depasturing, is particularly desired, the Broad-leaved Clover and Lucern are greatly superior.

The value of the herbage of Sainfoin is equal to that of the Broad-leaved Clover, and proportionally less than that of the Long-rooted Clover, as 10 to 11. The weight of crop being comparatively small on a soil of the nature above described, it is doubtless inferior. On dry hilly situations, and chalky soils, however, it may be their superior in every respect, on account of its valuable herbage.

The White or Siberian Melilot, which appears to be only a variety of the Long-rooted Clover, was cultivated by Arthur Young, Esq. as he informs us in his Annals of Agriculture. The produce, by drilling on a moist loam, with a cold marshy bottom, was seven and a half tons per acre. It was given to horses, working oxen, and calves, and they ate it very readily, some even greedily.

From the foregoing details, it is evident the Long-rooted Clover should be cut at the time of flowering. It can only be locally useful, as in instances where it is desirable to have the land ready to plough up before the beginning of August.

It flowers about the first week of July, and the seed is ripe in August.

Trifolium Melilotus officinalis. Melilot Trefoil, Common Melilot, King's Clover, Hart's Clover.

Specific character: Legumes racemed, naked, two-seeded, wrinkled; acute, stem erect. (Martyn).

Obs.—This is very nearly allied to the Long-rooted Clover. The root, however, appears to be strictly annual. The lower leaves are oblong wedge-shaped; the upper ones eliptical, they are more serrate, and smaller in every respect than those of the Long-rooted Clover. The flowers are smaller, and more drooping. The legume contains often more than two seeds, which is seldom, or, according to my experience, never the case in the Long-rooted Clover.

Native of Britain. Root annual.

Experiments.—At the time of flowering, the produce from a clayey loam, is,

	dr.	qr.	oz.		lbs.		
Herbage, 55 oz. The produce per acre - - - -			598950	0 =	37434	6	0
80 dr. of grass weigh, when dry -	80	0					
The produce of the space, ditto - -	330	0	224606	4 =	14037	14	0
The weight lost by the produce of one acre in drying - - - -			23396	8	0		
64 dr. of grass afford of nutritive matter -	2	1					
The produce of the space, ditto - -	30	$3\frac{3}{5}$	21056	13 =	1316	0	13

Horses and sheep are said to eat this clover, as are also cows, goats, and swine. Dr Withering says, that water distilled from the flowers possesses but little odour in itself, but improves the flavour of other substances. It does not appear to have been cultivated in England. Professor Martyn observes, that there cannot be a worse weed among bread-corn; for a few of the

Trifolium melilotus officinalis.

Melilot Trefoil.

seeds ground with it, spoil the flour, by communicating the peculiarly strong taste of the plant: notwithstanding this, horses are said to be extremely fond of it. Some Italian writers call it *Trifolium caballium.* In medicine it was esteemed emollient and digestive, and was used in fomentations and cataplasms, particularly in blister plasters; but it is now laid aside, as being more acrid and irritating than emollient.

From the above details it is very much inferior to the Long-rooted Clover, and cannot be put to any use, for which that species is not equally good or superior: it grows chiefly in clayey soils. In very exposed situations, it attains only to a small size; while in such as are much sheltered, I have found it exceeding six feet in height.

It ripens an abundance of seed. Flowers in the third or last week of June.

Vicia cracca. Tufted Vetch.

Specific character: Peduncles many-flowered; flowers imbicate; leafets lanceolate, pubescent; stipules half arrow-shaped, mostly entire.

Obs.—Root creeping, perennial. Stems quadrangular, weak, striated, attaining a great height when growing in hedges. Branches alternate from the axils of the upper leaves. Leaves alternate, consisting of from eight to twelve pair of leafets, and terminated by a long branched and curling tendril. Leafets oftener alternate than opposite, more or less hoary on both sides, with silky hairs, commonly rounded at the end, and terminated by a short point. Flowers of a purple or violet blueish colour. Legume half an inch long; containing four or five globular seeds, the size of a lentil. Fl. Rust. t. 117; Fl. Dan. t. 804; Wither. ii. 363; Engl. Bot. t. 1168.

Experiments.—At the time of flowering, the produce from a clayey loam in an exposed situation, is,

	dr.	qr.	oz.		lbs.		
Herbage, 16 oz. The produce per acre - - - - -			174240	0 =	10890	0	0
80 dr. of grass weigh, when dry - -	30	0					
The produce of the space, ditto - -	96	0	65340	0 =	4083	12	0
The weight lost by the produce of one acre in drying - - - - - - -			6806	4	0		
64 dr. of grass afford of nutritive matter -	2	0					
The produce of the space, ditto - - -	8	0	5445	0 =	340	5	0

This species of vetch is chiefly confined to woods and hedges, in its natural state: I have found it, in two instances, among the herbage of irrigated meadows. When growing among bushes, a space of ground, equal to that above mentioned, afforded 48 oz. of herbage, or three times the weight of that cultivated in an open situation. Dr. Plot, in his History of Staffordshire, says, that this and the *Vicia sylvatica,* advance starved or weak cattle above any thing yet known; and Dr. Anderson, in his Essays, speaks highly of this plant. It is inferior to common tares *(Vicia sylvatica),* in the quantity of nutritive matter it affords, but contains much less superfluous moisture. This must give it a superiority, in regard to nutrient properties, over Tares, which contain an excess. But it has a strong creeping root, that will always prevent its admission to arable lands. It might be best cultivated on tenacious soils, and used after the

Vicia cracca.

Tufted Vetch.

manner of Lucern, than which, though greatly deficient in the weight of crop, it is nevertheless more nutritive.

43 grains of the nutritive matter consisted of:

Saccharine matter or sugar - - - - - - -	20
Mucilage - - - - - - - - -	12
Insoluble and saline matters - - - - - - -	11

Flowers about the middle of July and the beginning of August, and the seed is ripe at the beginning of September.

Vicia sylvatica. Wood Vetch.

Specific character: Fruit-stalks many-flowered; leafets eliptic; stipula crescent-shaped, toothed.

Obs.—Stems running to a great height in the bushes, where it grows, and spreading widely, so as to choke its supporters. Leaves of six or nine pair of leafets, mostly alternate. Stipulæ in pairs, small, deeply divided into several awl-shaped segments. Flowers whitish, with beautiful pencil-streaks of blue. Pods lanceolate, smooth, pale brown. E. Bot. t. 79; Flo. Dan. t. 277; Wither. iii. 335.

Native of Britain, and most parts of Europe, from Sweden to the south of Italy; also of Siberia. Root perennial.

Experiments.—At the time of flowering, the produce from a clayey loam, is,

	dr.	qr.	oz.		lbs.	
Herbage, 12 oz. The produce per acre - - - -			130680	0 =	8167	8
80 dr. of herbage weigh, when dry - -	20	0				
The produce of the space, ditto - -	48	0	32670	0 =	2041	14
The weight lost by the produce of one acre in drying - - - - -			-	-	6750	10
64 dr. of herbage afford of nutritive matter -	2	2				
The produce of the space, ditto - -	7	2	5104	11 =	319	0

The habits of this Vetch are similar to those of the *Vicia cracca,* but it seems more impatient of exposure: it thrives better where it has the support of bushes. When transplanted to open situations, the produce is inconsiderable, compared to that of the *Vicia cracca,* or *Vicia sæpium;* though in its natural place of growth the produce is six times that of either of these Vetches, it is likewise superior in the quantity of nutritive matter it affords. Horses, cows, sheep, and the South American sheep, (lamala), ate this Vetch with more eagerness than they did the other Vetches or natural grasses that were on several trials offered to them.

Of all the different Vetches that were submitted to experiment, the Winter Tare, or Common Vetch, (*Vicia sativa,* var.), afforded the most nutritive matter. 64 dr. of the herbage, cut at the time of flowering, afforded 4 dr. 4 gr. of nutritive matter; Spring Tares afforded only 3 dr. 3 qrs., which confirms the justice of that preference which practice has given to the former.

Flowers in July and August, and the seed is ripe in September.

Vicia sylvatica.
Wood Vetch.

Lolium temulentum. Annual Rye-grass, Bearded Ray-grass.

Specific character: Spike awned; spikets compressed, many-flowered.

Obs.—This is distinguished from the Perennial Rye-grass by its bearded or awned spikets, by the roughness of the stem and leaves; leaves broader, of a paler green colour. For the distinguishing marks of the seed, see pages xxxiii. and xliv. of the Introduction.

Native of Britain. Root perennial. Flo. Rust. 33; Flo. Dan. 160; Engl. Bot.

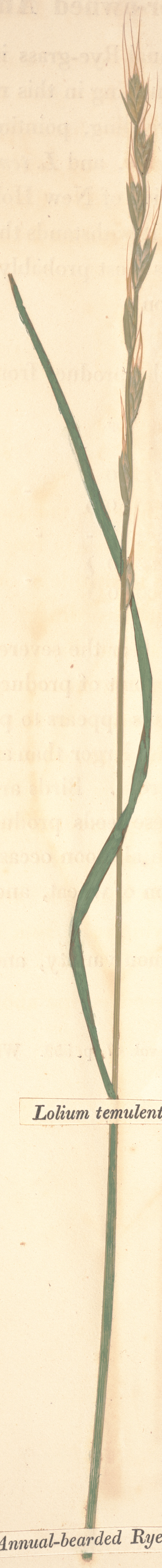
Experiments.—At the time of flowering, the produce from a rich sandy loam, is,

	dr.	qr.	oz.		lbs.	
Grass, 20 oz. The produce per acre	-	-	-	-	217800 0 = 13612	8
80 dr. of grass weigh when dry - -	40	0	-	-	108900 0 = 6806	4
The produce of the space, ditto - -	160	0				
The weight lost by the produce of one acre in drying			-	-	- - 6806	4
64 dr. of grass afford of nutritive matter -	70 gr.		-	-	- 7940 10 = 496	4
The produce of the space, ditto - -	350					

This is supposed to be the Darnel of the ancients, mentioned as hurtful to crops of Wheat. It has lived under the opprobrious name of *weed,* nearly two thousand years. It appears, from the trials that have been made of it here, to be incapable of outliving winter frosts; even in mild winters I never could preserve a single plant under ordinary circumstances. It is never, according to my experience or information, found beyond the precincts of tillage-fields. It is probable, therefore, that it owes its preservation or continuance in this country to the spring-sown annual crops of grain. It is reasonable to conclude from this circumstance, that it was not originally a native of this country, but may have been mixed with the grain imported from warmer climates.

The above statements shew the produce of one acre for one year. Being strictly an annual plant, it may be easily kept under, or totally extirpated, by the practice of the drill mode of husbandry. Indeed it is never found in arable lands that are managed under this superior system of tillage, except when introduced by having seed from other farms where broad-cast sowing is practised.

Flowers in the first week of July, and the seed is ripe about the beginning of August. The seeds vegetate quickly after being sown.



Lolium temulentum.

Annual-bearded Rye-grass.

Lolium temulentum, var. Slender-awned Annual Rye-grass.

Obs.—This differs from the Common Annual Rye-grass in having the calyx longer than the spikets; spikets more cylindrical, resembling in this respect the *Lolium tenue;* awns very weak; leaves smoother; root-leaves spreading, pointing horizontally. It partakes of the characters of the *Lolium tenue, L. arvense,* and *L. temulentum;* but evidently approaches nearest to the last. It is said to be a native of New Holland, being marked as such on the envelope of the seeds I received; but as it withstands the effects of the severest frosts, which utterly destroy the common sort, it is most probably, as Mr. Sowerby observes, only a British plant returned from transportation.

Root annual.

Experiments.—At the time of flowering, the produce from a siliceous sandy soil, is,

	dr.	qr.		oz.		lbs.		
Grass, 25 oz. The produce per acre - - - - -				272250	0 =	17015	10	0
80 dr. of grass weigh, when dry - -	35	0	- -	85359	6 =	5334	15	0
The produce of the space, ditto - -	175	0						
The weight lost by the produce of one acre in drying - - - - - - -				11680	1	0		
64 dr. of grass afford of nutritive matter -	80	0	- -	11343	12 =	708	15	0
The produce of the space, ditto - - -	500	0						

This variety is very hardy, being able to bear the severest of our winter frosts. It is considerably superior to the preceding species in point of produce, and affords a superior quantity of nutritive matter. But neither of these plants appears to possess sufficient merits to rank them above the class of annual weeds. The seeds are larger than any of the natural annual grasses, and approach to the size of the cultivated grain crops. Birds are very fond of the seeds. Linnæus says, that when mixed with bread corn, these seeds produce but little effect, unless the bread be eaten hot; but if malted with barley, the ale soon occasions drunkenness. It is said*, that when made into bread with a small proportion of wheat, and eaten repeatedly, it produced vomiting, purging, violent colics, and death.

Flowers about eight days before the common variety, and the seed is perfected nearly at the same time as that of that variety.

* Monthly Review, vol. 67, p. 559. Withering.

Lolium temulentum, var.

Slender-awned Annual Rye-grass.

Phalaris canariensis. Manured Canary-grass.

Specific character: Panicle spike-like, ovate; husks of the calyx boat-shaped, apex quite entire; corolla four-valved, outer smooth, inner villose.

Obs.—Culms from six inches to three feet high, according to the richness of the soil, erect, roundish, somewhat compressed; leaves linear lanceolate, acute, flat, rough; florets ovate compressed, outer convex, inner somewhat concave; nectary, two fleshy concave pear-shaped substances on the outside of the base of the corolla. Schrader; Engl. Bot. 1310; Flo. Rust. t. 17; Wither. iii. 113.

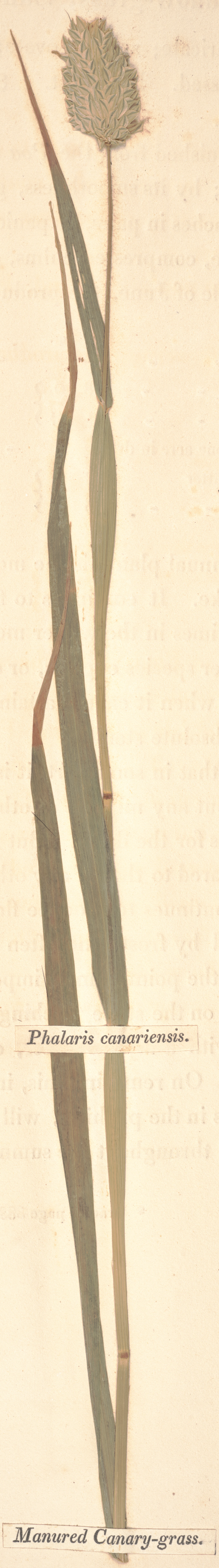
Native of the Canary Isles, also now of England, France, Spain, and New Zealand. Root annual.

Experiments.—At the time of flowering, the produce from a rich clayey loam on a tenacious subsoil, is,

	dr.	qr.	oz.		lbs.		
Grass, 80 oz. The produce per acre - - - - -			871200	0 =	54450	0	0
80 dr. of grass weigh, when dry - - -	26	0					
The produce of the space, ditto - -	416	0	283140	0 =	17696	4	0
The weight lost by the produce of one acre in drying - - - -			36753	12	0		
64 dr. of grass afford of nutritive matter -	1	2					
The produce of the space, ditto - -	30	0	20418	12 =	1876	2	0

This grass has been cultivated in England for the sake of its seeds only, which are esteemed the best for the smaller birds, particularly canaries; whence it takes its name. Its culture here appears to be chiefly confined to the Isle of Thanet. From the results of the above experiments, it proves a great impoverisher of the soil. A given space of a rich clayey loam afforded in the first season 80 oz. of grass, when cut at the time of flowering; the succeeding year, the same space was well worked and sown, but no manure was applied; the produce was only 9 oz. On the third year the ground was manured with decayed stable dung, at the rate of 70 cart-loads per acre; the given space then afforded 85 oz. of grass. The herbage is but little nutritive, and the plant cannot be recommended for cultivation but for the seeds only, which are principally in demand in the neighbourhood of large cities.

Flowers in the first week of July, and the seed is ripe about the end of August.



Phalaris canariensis.

Manured Canary-grass.

Poa annua. Annual Meadow-grass, Suffolk-grass.

Specific character: Panicle divaricate; spikets ovate; florets somewhat remote, five-nerved, free; culms oblique, compressed. Flo. Rust. t. 8; Engl. Bot. t. 1141; Huds. Angl. 42; Curt. Lond. 1. t. 6; Wither.

Obs.—The *Poa annua* is distinguished from the *Poa trivialis* by its general habit, its spreading panicle, and reclining culms; by its smoothness, greater softness, and delicacy; from *Poa pratensis*, by having the branches in pairs, its panicle more thinly set, and its spikets larger; from both, by its inferior size, compressed culms, and annual root. Martyn.

Experiments.—About the middle of June, the produce from a rich black loam, is,

	dr.	qr.	oz.		lbs.		
Grass, 8 oz. The produce per acre - - - - -			87120	0 =	5445	0	0
80 dr. of grass weigh when dry - -	28	0					
The produce of the space, ditto - -	44	$3\frac{1}{5}$	30492	0 =	1905	12	0
The weight lost by the produce of one acre in drying - - - -					3539	4	0
64 dr. of grass afford of nutritive matter -	2	2					
The produce of the space, ditto - -	5	0	3403	2 =	212	11	2

This, though a diminutive annual plant, is the most troublesome weed that infests gravel walks, stone pitchings, and the like. It continues to flower and produce seed all the spring, summer, autumn, and even sometimes in the winter months. The seed is perfected in a shorter space of time than that of any other species of grass, or of any plant with which I am acquainted. It will produce flowers and seeds when it cannot attain to more than an inch in height, from the soil being in the next degree to absolute sterility.

Mr. Stillingfleet informs us*, that in some parts it is called Suffolk-grass, there being whole fields of it in High Suffolk, without any mixture of other grasses; and he expresses an opinion, that it is likely to be the best grass for the dairy. But the diminutive size of the plant renders its cultivation unprofitable, compared to that of any other of the pasture grasses; and besides, it is an annual, which, though it continues to produce flowering culms during most part of the year, nevertheless is soon injured by frost, and often killed by a continuance of dry weather. How to extirpate it, therefore, is the point of most importance to be ascertained. Some recommend boiling water to be poured on the stone pitchings where it abounds; but the most effectual mode is to cover the spot with a layer of litter, or the mowings of the lawn, in sufficient thickness to create fermentation. On removing this, in the course of ten days or a fortnight, the *Poa annua*, and most other weeds in the pitching, will be found completely destroyed.

It flowers and ripens the seed throughout the summer.

* Tracts, page 383.

Poa annua.
Annual Meadow-grass.

Triticum repens. Creeping Wheat-grass, Couch, Quitch, Dog's-grass, Quicks.

Specific character: Calyxes 5-flowered, awl-shaped, many-nerved; florets acuminate; leaves flat; root creeping.

Obs.—Root perennial, powerfully creeping, jointed, coated, fibres downy. Stems slender, upright, two feet high, but acquire a much greater height when drawn up in hedges, round, smooth, striated, having five or six joints, which are frequently tinged with red. Leaves spreading very much, smooth on the under surface, on the upper and the margin rugged; they are often directed on one side. Spike nearly upright, two or three inches long, flat, composed of numerous spikets, often more or less awned. Flo. Rust. t. 124; Engl. Bot. 909; Huds. 57; Wither. Arr.; Smith Brit. 158; Flo. Dan. t. 784.

Experiments.—At the time of flowering, the produce from a clayey loam, is,

	dr.	qr.		oz.		lbs.		
Grass, 18 oz. The produce per acre -	-	-	-	196020	0 =	12251	4	0
80 dr. of grass weigh, when dry - -	32	0	- -	78408	0 =	4900	8	0
The produce of the space, ditto - -	115	0½						
64 dr. of grass afford of nutritive matter -	2	0	- -	6125	10 =	382	13	10
The produce of the space, ditto - -	9	0						

64 dr. of the roots afford of nutritive matter 5 dr. 3 qr. The proportional nutritive powers of the roots, is therefore superior to that of the herbage as 8 to 23.

This species constitutes the principal of what is termed Couch-grass in gardens or rich cultivated grounds. The *Holcus mollis* and *Poa pratensis,* are the proper Couch-grasses of light or sandy soils. The *Agrostis alba* is chiefly troublesome as *couch* in clayey lands. Forking out the roots after the plough, is doubtless the best mode of extirpating this noxious weed; but the process must not be discontinued while a particle of the root is suspected to remain in the soil, as the least portion will grow, and the land being so much broken and loosened by the operation, gives double encouragement for the rapid growth of the plant. It does not thrive well when combined with other grasses, but is naturally more common in hedges.

The roots contain a large proportion of nutritive matter; they are esteemed abroad for feeding horses. At Naples, they are collected in large quantities for this purpose, and brought to market. My kind friend, Mr. Thomas Roy, sent me some of these roots from Naples; they were much larger than any I had seen of British growth. On trial, the given quantity afforded 6 dr. 2 qr. of nutritive matter; being, in this respect, superior to the English roots in the proportion of 26 to 23. Boerhaave recommends the juice of the root to be drunk liberally in obstructions of the viscera, particularly in cases of schirrhous liver and jaundice. Dogs eat the leaves of this grass, and also those of the *Holcus avenaceus,* to excite vomiting. The nutritive matter from the leaves contain an excess of bitter extractive and saline matters.

Flowers about the beginning of August, and the seed is ripe about the end of the same month; but it is seldom good, being subject to mildew.

Triticum repens.

Couch-grass.

Millium effusum. Common Millet-grass.

Specific character: Flowers panicled, dispersed, awnless.

Obs.—Stems generally rising to three or four feet in height, with about four joints. Leaves smooth, thin, and weak. Panicles from four inches to a foot in length; branches loose. Pedicels often in whirls, diverging by glands fixed in the axils, which has caused it to be mistaken sometimes for the *Poa retroflexa* or *P. distans.* Mr. Curtis observes, that it is distinguished from the panics, to which it has the greatest natural affinity, by having a calyx of two valves only. Engl. Bot. 1106; Curt. Lond. iv. 12, 248; Wither. Arr.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a light sandy soil, is,

	dr.	qr.	oz.		lbs.	
Grass, 11 oz. 8 dr. The produce per acre - - - - - - -			125235	0 =	7827	3
80 dr. of grass weigh when dry - -	31	0	- -	48528	9 =	3033	0
The produce of the space, ditto - -	111	$2\frac{2}{8}$				
The weight lost by the produce of one acre in drying - - - -						4794	3
64 dr. of grass afford of nutritive matter -	1	3	- -	3424	10 =	214	0
The produce of the space, ditto - -	5	$0\frac{5}{16}$				

The common Millet, in its natural state, seems to be confined to woods as its place of growth. It will thrive and grow, however, when transplanted to open exposed situations. It is remarkable for the lightness of the produce in proportion to its bulk. The foliage comes pretty early in the spring, but appears, from the above results, to be but little nutritive. Birds are remarkably fond of the seeds; so much so, as to raise a doubt whether, for the sake of the seed only, it could be cultivated to advantage on the farm. But in covers, where game is preserved, there cannot be a better grass encouraged: it will save the corn fields. About the beginning of August is the best season for sowing the seed. The surface of the ground, near the roots of the bushes, should be lightly stirred, and the seeds scattered over it and raked in; a few of the decaying leaves that cover the ground, should be afterwards thrown over it.

It flowers in the second week and latter end of June, and the seed is ripe in the middle of July, and beginning of August.

Milium effusum.

Common Millet-grass.

Agrostis Mexicana. Mexican Bent-grass.

Specific character: Panicle oblong, heaped; calyx and corolla acuminate, and nearly equal.

Obs.—Culms numerous, from one to two feet high, according to the nature of the soil it grows in, branched, erect; leaves smooth, sheath-scale truncated; panicle pale green, tinged with purple, according as it is produced in full exposure to the sun, crowded with scabrous florets; calyx-valves unequal, shorter than the corolla; corolla-valves nearly equal, hairy at the base. Linnæus observes, that it is very difficult to distinguish this species. Native of South America. Root perennial. Introduced into England by Mr. Gilbert Alexander in 1780. Hort. Kew. i. p. 150; Linn. Mant. 31, syst. 111.

Experiments.—At the time of flowering, the produce from a rich black siliceous sandy soil incumbent on a tenacious subsoil, is,

	dr.	qr.	oz.		lbs.		
Grass, 28 oz. The produce per acre - - - - - - -			304920	0 =	19057	8	0
80 dr. of grass weigh, when dry -	28	0					
The produce of the space, ditto - -	156	$3\frac{1}{5}$	106722	0 =	6670	2	0
The weight lost by the produce of one acre in drying - - - -					12387	6	0
64 dr. of grass afford of nutritive matter -	2	0					
The produce of the space, ditto - -	14	0	9528	12 =	595	8	12

It delights more in calcareous or clayey soils than in those that are of a siliceous sandy nature. It perfects an abundance of seed, which, when sown, produces plants that soon arrive at perfection. So far, therefore, it possesses the requisite properties of a grass adapted for the Alternate Husbandry; but it is late in the produce of foliage in the spring, and that herbage is not distinguished by any superior nutritive powers, as the above results of experiments manifest. It is perfectly hardy. Being a native of a warmer climate, its defects may possibly be greatly lessened by being naturalized, and by frequently raising it from seed successively ripened in this country. At present, it does not offer any strong reasons to recommend it further to the notice of the Agriculturist.

It flowers in the third week of August, and the seed is ripe towards the end of September.

From the facts brought forward in this and the preceding Series, it appears manifest there are but a small number of the natural grasses peculiarly fitted for the Alternate Husbandry.

The merits of a grass, or other species of plants for alternation, as green crops*, with grain, were before mentioned.

* The following plants having been submitted to experiment, in so far as regards the quantity of nutritive matter they afford, it is hoped the accompanying short notices respecting them may not be altogether uninteresting, but of some use to the Agriculturist.

1. Turnips, *(Brassica rapa).* By whom, and at what period, Turnips were first used in England as the food of cattle, does not appear. But from various accounts, their culture and uses were known in the Low Countries, as far back as there are any records. The ancients appear to have been well acquainted with the value of this root. Columella, speaking of the several kinds of vegetables adapted for the farm, recommends the cultivating of *Rapa* in plenty, because, says he, those roots that are not wanted for the table, will be eaten by the cattle.

Agrostis Mexicana.
Mexican Bent.

The meadow foxtail, *(Alopecurus pratensis)*, is early, productive, and nutritive, but it does not arrive at perfection so soon as many other grasses. The seed is also often defective.

Woldridge, in his Mystery of Husbandry, &c. printed in 1681, (my copy I believe to be a second edition, for Woldridge wrote in 1668), says, that "although Turnips be usually nourished in gardens, and be properly a garden plant, yet are they, to the very great advantage of the Husbandman, sown in his fields in several places of England, not only for culinary uses, as about London and other great cities, but also for the food of cattle." Again he says, that "in Holland they slice their Turnips with the tops, and Rape-seed cakes, and grains, &c. and therewith make mashes for the cows, and give it them warm, which the cows eat like hogs." He likewise complains of the "very great neglect and deficiency of English husbandry in this particular."

Lord Viscount Townshend appears to have the merit of occasioning their culture to be carried to a great extent in England. His Lordship was Embassador to the States-General in 1709, and afterwards retired to Rainham, in Norfolk; in which county the culture of Turnips has been brought to the highest state of perfection by Mr. Coke. In most counties in Scotland the culture of Turnips has also arrived at a great height, and appears to be more general than in many parts of England. Sir John Sinclair* informs us, that the seed of the Swedish Turnip was first introduced into Scotland in 1781-2, on the recommendation of Mr. Knox, a native of East Lothian, who had settled at Gallowburgh, whence he sent some of the seeds to Dr. Hamilton.

The culture of the common Field Turnip is most advantageous on light or sandy soils; it enables the Farmer to adopt a profitable rotation of crops on such soils as would not otherwise admit of it, nor support live stock during the winter, much less prepare them ready for market, without great expense in the use of hay. The Swedish Turnip, or Ruta Baga, is equally valuable for heavy soils that are not well fitted for the common Field Turnip.

Manure is essential in the culture of the Turnip, which, like all tuberous or bulbous roots that require it, thrives better with *short* than *long* dung. There is no mode of applying it so effectually as that of burying it in the ridges made for the purpose of the drills; because the dung in this case becomes as it were a hot-bed for the young plants, encouraging their growth in a high degree, which is of great effect in defeating the attacks of the turnip-fly. The Swedish Turnip is a great acquisition to the Husbandman, for tenacious soils. It is seldom injured by frost, and though less productive in the average weight of crop, contains much more nutritive matter than the Common Turnip, as much as 3 to 2. When sown *broad-cast* the produce is seldom more than half the weight of that *drilled* on ridges, though on the same soil.

The nutritive powers of the different varieties of Turnips appear to be as follows:

64 dr. of the Swedish Turnip, or Ruta Baga, afford of nutritive matter - - - -	110 grains.
64 dr. of the Stone, or Garden Turnip, ditto ditto - - - - - - - -	85
64 dr. of the Common, or White Loaf, ditto ditto - - - - - - -	80
64 dr. of the Tankard, or Long rooted, ditto ditto - - - - - - - -	76
64 dr. of the Norfolk White Turnip, ditto ditto - - - - - - - -	83

The quantity of nutritive matter contained in different roots of the same variety, varies according to the size and texture of their substance. A root of the White Loaf variety, measuring seven inches in diameter, afforded only seventy-two grains and a half, while the same quantity of a root which measured only four inches, afforded eighty grains. The middle-sized roots of the Common Turnip are therefore the most nutritious; as on the contrary, are the largest roots of the Swedish Turnip, affording 110 grains, while the middle-sized and smaller roots afforded only 99.

100 grains of the nutritive matter of White Turnips appeared to consist of mucilage 16, sugar 82; albumen or gluten 2 = 100 grains.

2. Cabbages, (*Brassica oleracea*, var.), are of great value under the circumstance of a tenacious heavy soil, where the turnip culture cannot be practised with advantage. They require to be raised from seed sown in beds of earth in autumn or spring, and transplanted into the field towards the end of May, or beginning of June at farthest; and will be ready for use in October. It is essential that the seed-beds have good shelter, but at the same time free exposure to the sun, morning, mid-day, and noon. The soil a rich friable loam. One pound of seed, if properly treated, will produce 24,000 plants, and 8000 plants are considered sufficient for an acre of land. For the purposes of the Dairy, one acre of Cabbages is considered worth three of Turnips. There has been some difference of opinion with respect to their effects on the quality of the milk and butter; but they are evidently superior to Turnips as long as they keep fresh; one or two decaying leaves upon a head, however, are sufficient to give both milk and butter a strong disagreeable taste. This I have long had an opportunity of proving.

The varieties of the Cabbage are numerous. Those best fitted for field-culture are the Drum-headed Cabbage, Red-veined, the Scotch, or Yorkshire, and the American. The most productive of these are the Drum-headed and American, but the Red-

* Account of the Systems of Husbandry in Scotland, &c. by Sir John Sinclair, Bart. Founder of the Board of Agriculture.

Meadow cat's-tail, *(Phleum pratense)*, arrives speedily at perfection. It is very productive in the fore part of the season, and the foliage and culms are very nutritive; but it runs much to stalks, and the after-grass is very trifling.

veined and Scotch stand the winter best. This plant impoverishes the soil very much; in collecting the produce for consumption, the plants should therefore be drawn up by the roots, and not merely cut over, as is often practised to the detriment of the soil. These different varieties afford about equal quantities of nutritive matter.

64 dr. of the Drum-headed Cabbage afford of nutritive matter, 140 grains.

Swedish Turnips are therefore inferior to Cabbages in the quantity of nutritive matter they afford, in the proportion of 7 to 6; and the common Field Turnip is inferior in the proportion of 7 to 4. Carrots are more nutritive than Cabbages, in the proportion of 9 to 7.

3. Potatoes, *(Solanum tuberosum)*. The varieties of the Potatoe are very numerous, and the confusion of their names inextricable. Those most valued in the field-culture are the Ox-noble, Yam, Champion, Purple-red, Rough-red, Hundred-eyes, Yorkshire Kidney, and Moulton White. Though there is some difference of opinion respecting the time when this most valuable root was first cultivated in Great Britain, as also of the individual to whom we are indebted for its introduction; yet the most authentic records agree in giving the merit to the illustrious Sir Walter Raleigh, who brought it from Virginia in 1584. "The President of the Royal Society," Sir R. Southwell, "related that Potatoes were first introduced into Ireland by his grandfather, who had them from Sir Walter Raleigh, after his return from Virginia*.

The culture of Potatoes is well known. They are a very impoverishing root to the soil.

The Yam Potatoe is very productive, attains to a large size, but is often hollow, and less nutritive than most others. 64 dr. afford of nutritive matter 222 grains, which consist of starch 192 grains, and saccharine and albuminous matter 30.

The Ox-noble is a very productive variety, contains more nutritive matter than the Yam, but less than several others. 64 dr. afford 235 grains of nutritive matter, consisting of starch 198, and saccharine, mucilaginous, and albuminous matters 37.

The Purple red Potatoe is smaller than the preceding, but well-flavoured and very prolific. 64 dr. afforded me 241 grains of nutritive matter, which appeared to consist of starch 204, albuminous and saccharine matters 37 grains.

The Hundred-eye variety is very prolific on dry loams; it contains rather more nutritive matter than the foregoing. 64 dr. afford 276 grains of nutritive matter, which afforded, starch 216 grains, albuminous, and other matters 60.

The Rough-red produces plentiful crops on soils of a moister nature than that adapted for the *Hundred-eyed* variety; it is well-flavoured. 64 dr. afforded 308 grains of nutritive matter, which consisted of starch 252, and saccharine, mucilaginous, and albminous matters 56.

Champion, this variety grows to a moderate size, is very productive, and but little subject to the *curl* disease. 64 dr. contain 378 grains of nutritive matter, consisting of starch 208, mucilage, sugar, and albumen 90.

Carrots, *(Daucus carota)*. The Garden, or cultivated Carrot, is supposed to be an accidental variety of the Wild Carrot, a common weed in sandy loams, (see Engl. Bot. 1174). There are four varieties of the common Carrot, distinguished by their colour; as the Long-red, the Orange, the White, or Walcheren, and the Early-horn Carrot. The soil which answers to the turnip-culture is likewise adapted for the Carrot; but it requires to be deeper. The highly nutritious nature of this root is well known; it is excellent food for all sorts of cattle, particularly horses. Swine are said to fatten sooner on Carrots than on any other kind of food, and the flesh is superior. The only objection to the general adoption of the cultivation of Carrots, is their impoverishing effects on the soil, and the root does not succeed well if manure be applied with the crop. The most successful mode I ever witnessed of raising Carrots in the field, was precisely the same as that of Turnips, with the exception that no manure was applied with the crop. The seeds were drilled on ridges, about the end of March, in dry weather, and on gaining their fourth leaf, about the middle of May, were thinned out, and first-hoed, vacancies being filled up by transplanting from the crowded spots. The produce about 300 bushels per acre. The Long-red Carrot is the most productive, but the Orange variety is more certain for a crop. Carrots are superior to Turnips, in being more nutritive, more hardy, and less subject to disease, and continue good till a later period in the spring. But their effects on the soil unfit them for alternation as a green crop with grain. The expense of reaping the produce is also greater than that of Turnips. The growers of this root affirm, that one acre of it will feed as many cattle as three of Turnips, which exactly agrees with the comparative weight of nutritive matter afforded per acre, Carrots being superior to Turnips as 3 to 1. 64 dr. afforded 187 grains of nutritive matter, 100 grains of which, according to Sir H. Davy, consist of sugar 95, mucilage 3, and extract $\frac{1}{2}$.

The White Carrot appears to contain more sugar. 64 dr. afforded 190 grains of nutritive matter, 100 of which gave sugar 98, mucilage 2, and extract 1.

* Minutes of the Royal Society, December 13, 1693.

Rye, or ray-grass, *(Lolium perenne)*, comes soon to perfection, and when in a young state, produces a plentiful supply of early foliage. After the time of flowering, however, it produces

Mangel-Wurzel, Root of Scarcity, Lettsom Root, White Beet. (*Beta cicla, Racine de disette*). This variety of Beet appears to have been introduced to the Agriculturists of this country by Mr. Parekyns, who sent the seeds from Metz, in 1786, with directions for its culture*. Dr. Lettsom did much to recommend it for field-culture. It requires a rich deep soil. Some recommend the seeds to be sown in March or April, and as soon as the roots attain to the size of a goose-quill, to be transplanted, 18 inches plant from plant in the rows. But with this as with all bulbous and tuberous roots, transplanting does not tend to increase the size of the root, as those tuberous-rooted esculent vegetables in general do much better when not transplanted. The reports of the weight of crop produced on suitable soils, make this the most productive of esculent plants. But it impoverishes the soil in a high degree, even more than carrots. The weight of nutritive matter afforded by Mangel-Wurzel was before stated; it is superior to Turnips, and Carrots, and inferior to Cabbages and Potatoes.

Kohl Rabi, Bulb-stalked Cabbage, (*Brassica oleracea*, var.). This curious variety of Cabbage is a native of Germany, where it is much cultivated. They take it up before the frost sets in, and protect it like Potatoes or Turnips, for winter use. The produce is nearly the same as that of Swedish Turnips, and the soil that suits the one, is equally good for the other. It may either be sown in drills, or raised in beds, and transplanted like Cabbages: in this case, the beds require to be made and sown the preceding autumn. Two pounds of the seed will produce a sufficiency of plants for one acre of ground. The stem is swoln like a bulb, and when divested of the leaves, may readily be mistaken for one. Hares are so fond of it, that on farms where these animals abound, the culture of this plant is found to be impracticable. Sir Thomas Terwhit first introduced Kohl Rabi into England from Germany. In 1805, Messrs. Gibbs and Co. seedsmen to the Board of Agriculture, raised one ton and a quarter of the seed, and continue to supply the demands of the public for it, and for all other Agricultural seeds of the best quality. 64 dr. of the bulb of Kohl Rabi afford 105 grains of nutritive matter.

Burnet, *(Poterium sanguisorba)*. This plant is a native of Britain, growing in dry upland pastures and calcareous soils. It was first introduced to the notice of the Agriculturist by Mr. Rocque, of Walham Green, in 1760. *Ann. Regist.* Since that period the numerous trials that have been made of it, as a plant for pasture and for hay, have not proved it superior to Lucern, Saintfoin, or Clover, except in soils where these plants do not succeed. The chief property that gives value to Burnet, is its hardy nature, keeping green all winter, and its early growth. If left uncut in autumn, it will afford green food from October till April. On soils suitable to its growth, a portion of ground set apart for the growth of Burnet, would therefore be attended with considerable profit. 64 dr. afford of nutritive matter 100 grains.

Oriental Bunias, (*Bunias orientalis*). This is a native of the Levant and Russia. It was cultivated in 1739 by Philip Millar, in the Botanic Garden of Chelsea. It appears to have been first introduced into the field culture by Arthur Young, Esq. from whom Messrs. Gibbs and Co. had the seeds, which they have since increased in sufficient quantity to supply the farming public. The manner of growth of the roots and leaves resembles that of the Dandelion. It is not a very early plant, but bears mowing well. It is less productive than Chiccory, and is cultivated in the same manner as that plant, and applied to the same uses as food. Its nutritive qualities are equal to those of the broad-leaved Clover. 64 dr. of the stems and leaves, at the time the seed is ripe, afford 100 grains of nutritive matter; the same weight of leaves, cut at the beginning of May, affords only 70 grains.

Hogweed, (*Heracleum Sphondylium*). I was first led to submit this plant to experiment, at the suggestion of the Rev. S. Bale, of East Grinstead, who favoured me with seeds of another species, the *H. giganteum*. He observes, that it is a very early and productive plant, bears mowing well, and that it is much relished by cattle. Gmelin says, that the Russians distill an ardent spirit from the stalks; they prepare it, by fermenting the stalks in water with the marsh whortle-berry, *Vaccinium uliginosum*, which is more agreeable to the taste than spirits made from corn. Cows, sheep, swine, and rabbits, appear to be very fond of the leaves. It comes into flower about the middle of May. Its nutritive powers appear to be considerable, when compared to those of Lucern and some other plants.

About the first of May,	64 dr. of the herbage afford of nutritive matter	90 grains
Ditto,	ditto of Lucern,	90
Ditto,	ditto of Burnet,	100
Ditto,	ditto of *Bunias orientalis*,	100
Ditto,	ditto of the Broad-leaved cultivated Clover,	80

Yarrow, *(Achellia millifolium)*, or Thousand-leaved Grass, has long been considered a bad weed in pasture, and arable lands. It has a creeping root, which is difficult to extirpate on light soils. Sheep are said to be fond of it, and Dr. Anderson has re-

* Trans. Soc. Art. Vol. V.

comparatively nothing during the rest of the season; and unless the culmns are mown previous to ripening the seed, the ground is much impoverished by it.

Hard fescue, *(Festuca duriuscula)*, early attains to maturity; the culms are succulent and nutritious, grows quickly after being cropped, and springs pretty early; but it is very deficient in the weight of produce.

Meadow fescue, *(Festuca pratensis)*, is very productive and nutrient, but does not spring sufficiently early, and seldom attains to perfect maturity in two years.

Tall oat-like soft-grass, *(Holcus avenaceus)*, attains to maturity from seed in a very short space of time. It is very early and productive in the spring, and during the whole season, grows rapidly after cropping, and the culms are succulent. The produce, however, is very deficient of nutritive matter, which contains an excess of the bitter extractive and saline principles.

Yellow oat-grass, *(Avena flavescens)*, arrives soon at perfection; the produce is tolerably nutritive, but deficient in quantity.

Rough-stalked meadow-grass, *(Poa trivialis)*, early attains to maturity; the produce is highly nutrient, but likewise deficient in weight.

Smooth-stalked meadow-grass, *(Poa pratensis)*, is early, and rather nutritive, but comparatively unproductive. The creeping roots unfit it for introduction on arable lands.

Crested dog's-tail, *(Cynosurus cristatus)*, is backward in arriving at maturity. The produce is very nutritive, but wanting in weight.

Fertile meadow-grass, *(Poa fertilis)*, soon attains to maturity; the produce is highly nutritive, but comparatively deficient in quantity.

Nerved meadow-grass, *(Poa nervata)*, is productive, very nutritive, and affords an abundance of early foliage; but it does not attain to its full productive powers in two years.

Narrow-leaved meadow-grass, *(Poa angustifolia)*, is greatly superior to the Smooth-stalked Meadow-grass in early growth, produce, nutrient properties, and reproductive powers; but, unfortunately, it possesses a strong creeping root, which exhausts the soil, and renders it inadmissible on arable lands.

commended it for cultivation; but its productive and nutrient properties are very inferior to many other plants equally adapted to light soils. Linnæus says, that its properties are vulnerary and styptic. An essential oil is extracted from the flowers. 64 dr. of the leaves and stems cut when in flower, (June 26), afforded 98 grains of nutritive matter.

An ointment made of the leaves is reckoned good against the scab in sheep. There is every reason to believe, that Yarrow is only useful as a part of the food of cattle, in a medicinal point of view.

Chicory, Succory, *(Cichorium intybus)*. This plant is common on the borders of corn-fields, and poor gravelly soils. The cultivated variety was first pointed out as a plant for cultivation, in this country, by Arthur Young, Esq. who brought the seed from France in 1788. In some instances, it appears by Mr. Young's experiments, to be more productive than Lucern, (*Annals of Agriculture*). Succory has broad succulent leaves, and the stems become hard with age; it is therefore unfit to be made into hay. 80 dr. of the herbage lost in drying 52 dr. which shews it is more difficult to make into good hay, than the clovers. The quantity of seed required to sow one acre is thirteen pounds, but a good deal depends on the richness of the soil. It requires to be sown in drills.

64 dr. of the herbage, cut previous to the time of flowering, afforded 60 grains of nutritive matter.

Wood meadow-grass, *(Poa nemoralis)*, soon arrives at maturity, and springs early; the spring herbage is likewise very nutritive, and produced in considerable quantity. The after-grass in the autumn is, however, very inferior.

Flat-stalked meadow-grass, *(Poa compressa)*, affords much nutritive matter, and continues to vegetate from spring till autumn; but its deficiency, with regard to weight of produce, puts it out of the question for the purpose of alternate cropping.

Darnel-like fescue, *(Festuca loliacea)*. This grass possesses all the valuable properties of Rye-grass, and few of its defects. It would, doubtless, be the best substitute for that species in alternate cropping; but, unfortunately, it does not perfect a sufficiency of seed.

Cock's-foot, *(Dactylis glomerata)*, though not possessing every excellence in a degree superior to those species now mentioned, for the Alternate Husbandry, nevertheless, it appears to have a greater variety of merits for this purpose, than almost any other grass. It soon arrives at maturity; it bears cropping well, is very productive, and its nutritive powers are considerable. It is much less impoverishing to the soil than Rye-grass, and when ploughed in, affords a greater quantity of vegetable matter to the soil. It has been objected to Cock's-foot, that it rises in tufts, and is apt to become coarse. But the objections will apply to every grass that is not sown sufficiently thick to occupy, with plants, every spot of the ground, and that is not afterwards sufficiently stocked to keep the surface in a succession of young leaves. It is the practice of thin sowing, and the strong reproductive powers of the plant, that occasions it to appear a hassocky grass. If one species only is therefore thought preferable to several, in the Alternate Husbandry, there is scarcely a species to be preferred to the *Dactylis glomerata*. But with respect to an early and certain supply of the most nutritious herbage throughout the season, it will be found a vain labour to look for it in one species of grass, but only where Nature has provided it, in a combination of many. It will likewise be found, that the *Dactylis glomerata*, from its more numerous merits, should constitute three parts of a mixture of grasses adapted for the purposes of the Alternate Husbandry. The different species most proper to combine with Cock's-foot, are such as possess in a greater degree the properties of which this grass is deficient. For this purpose, none appear better fitted than the *Festuca duriuscula*, *Poa trivialis*, *Holcus avenaceus*, *Phleum pratense*, *Lolium perenne*, and White Clover, which should be in a smaller proportion. A combination thus formed, of three parts Cock's-foot, and one part of these species just mentioned, will secure the most productive and nutritive pasture in alternation with grain crops, on soils of the best quality; and even on soils of an inferior nature, under the circumstances of unfavourable seasons, will afford nutritive herbage, when otherwise the land would have been comparatively devoid of it, if one species of grass only had been employed.

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